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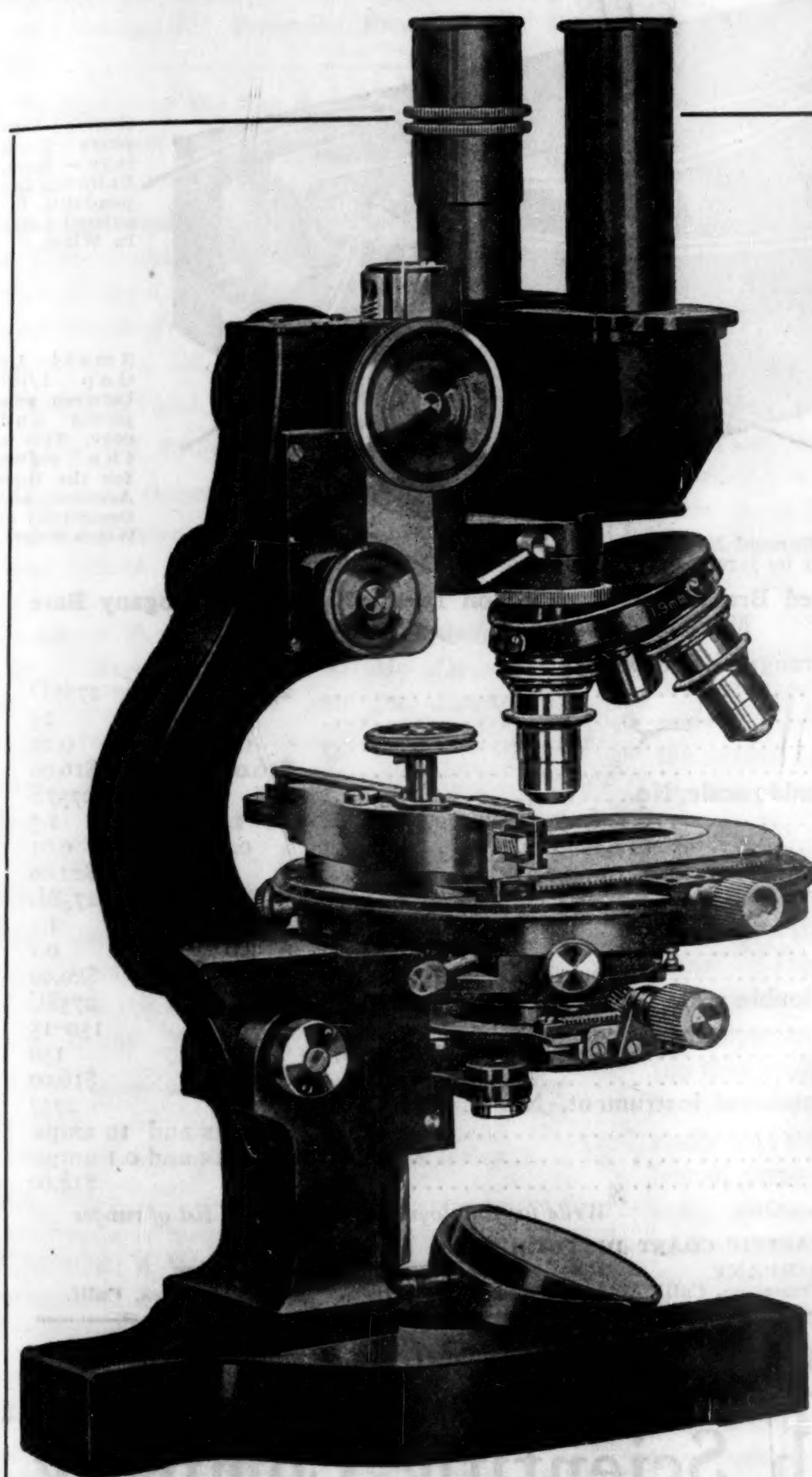

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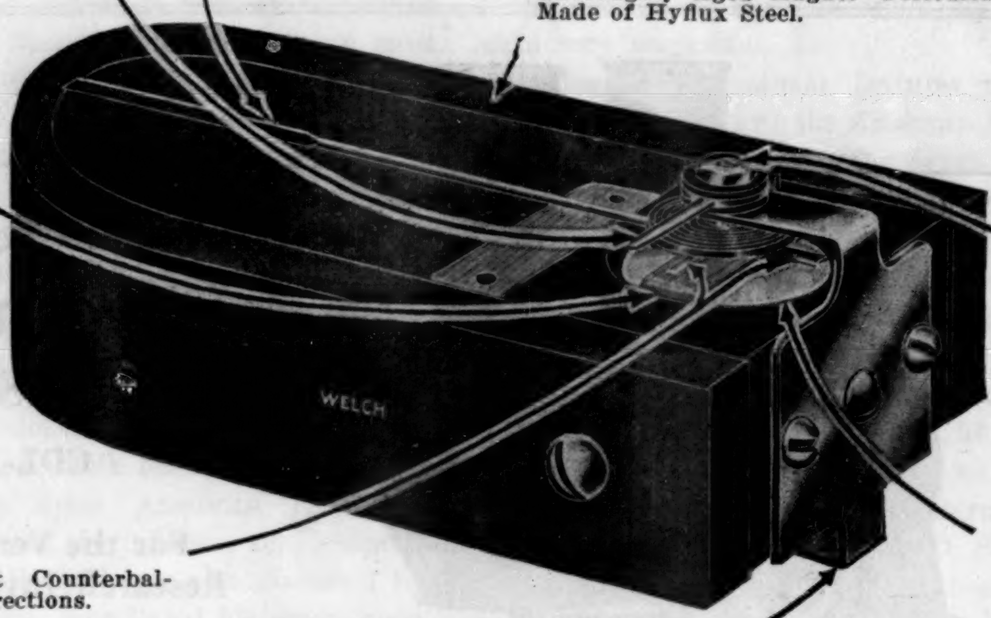

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CONTENTS

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THE PRESENT TENDENCIES AND METHODS OF PHYSIOLOGICAL TEACHING AND RESEARCH[1]

SOME thirteen months ago, at my inaugural lecture at University College, London, an occasion which represented also the completion of the great gift which that college owes to the Rockefeller Foundation, I had the temerity to speak upon an analogous though narrower subject, "The present tendencies and the future compass of physiological science." I say narrower, since in that lecture I attempted to deal only with the side of research: to-day I am even more rash—I propose to lay down the law also on an aspect of the subject of which I am still less competent to judge, its rôle in education.

On the former occasion I was astonished to find, in spite of the nature of some of my conclusions, how little immediate opposition was aroused. None of my more conservative colleagues wrote to deplore my Bolshevistic tendencies: none of my older friends came to expostulate with me in private: the only public comment I evoked was one in the *British Medical Journal,* approving much of what I said, but somewhat reproachful because I had discussed only the science and not the teaching of physiology. I will try to remove that reproach this evening.

THE INTERNATIONALISM OF PHYSIOLOGY

On that previous occasion, as on this, I started by stressing the international nature of scientific relations. Science and medicine can progress only by being truly international, by utilizing the discoveries and experience of all workers in all lands, by creating that good feeling and understanding between men in every country, which is the basis of cooperation in study and research. Science is not a purely intellectual thing: the history of learning throughout the ages, up to the present time, is a sufficient witness of that truth. Like any human enterprise it depends upon the human factors of courage and persistence, of good will, fellowship, trust and comprehension. These human factors were the basis of the Rockefeller gift to University College, of which I spoke a year ago. No less are they the basis of the invitation with which you to-day have honored me, a stranger, in asking me to give this annual address.

You may reflect: "Why, surely such sentiments are not controversial, they will arouse no bitterness or

[1] Annual Gross Lecture to the Pathological Society of Philadelphia.

contradiction!" In the abstract—no. Yet let us consider the concrete case. In 1923 an International Congress of Chemists met in Cambridge; the Germans—among them the most distinguished of living chemists—were forbidden to attend. In 1924 an International Congress of Mathematicians met in Toronto, with a similar restriction. In 1923 an International Congress of Physiologists met in Edinburgh: Germans, Austrians and Hungarians came, under the chairmanship of an Englishman who had lost two sons, killed in the war: the French and the Belgians stayed away in protest. In defence of the prohibition at Toronto it was urged (privately to me) that it was a lesser evil to hinder the advance of science than to run the risk of associating with men who signed the German professors' manifesto of 1914. Of the prohibition at Cambridge no defence was deemed necessary. And yet in 1796 a distinguished French scientific sailor, a prisoner of war in England, Chevalier de Rossel, dined in London as a guest of the Royal Society Club: while in 1802, within six months of the end of the long and bitter struggle which closed with the Treaty of Amiens, a number of eminent French officials, and at least one scientist, had done the same. In such a degree have we gone back instead of forward in our civilization. It is not unnecessary to protest the international status of learning.

Physiology as a Science

Mankind makes all kinds of excuses for its beliefs; the excuses are often not the real reasons; the real reason doubtless for what I am now going to say is that I have no medical qualifications myself, and naturally try to find excuses why physiologists should have no medical qualifications. You may discount what I say as far as you find necessary, bearing that in mind. These, however, are the excuses which I offer.

Physiology in Britain, but not always or usually in other countries, is in the faculty of science, as well as in the faculty of medicine. Our recruits are not drawn mainly from medical students or from qualified medical men. To that, I believe, the present high standard of physiology in Britain is largely due. With us physiology is no more "the handmaiden of medicine" than physics is the handmaiden of chemistry. Physiology may be necessary to medicine, medicine to physiology; but physiology has its own needs, its own problems, its own methods and habits of thought. In the solution of its problems physiology should no more be led by apparent utility than should physics. If a problem be unsolved, it is worth solving; if a phenomenon appear mysterious, it must be investigated; if two facts seem to be related, the relation must be explored; quite independently of the supposed utility or uselessness of the inquiry. The nervous impulse, muscular contraction, ciliary movement, the physical chemistry of hemoglobin require no more excuse for their study than does the structure of the atom. Whenever and wherever we see an opening for research, there the attack must be delivered, quite regardless of whether the results to be achieved are to benefit mankind, to enrich the medical profession or merely to satisfy our intellectual curiosity. For we can not judge whither our researches are to lead. This again may seem obvious; but it is not. Yes, one will be told, all very well in theory, but the department of physiology was built and endowed so handsomely because of its relation to medicine: were it not for the needs of medicine, physiology would be housed and treated with much less honor and indulgence. I am aware of that; it is primarily in order to secure the greatest possible return that one demands freedom. The gift of freedom, however, requires faith on the part of the giver; discipline, organization, servitude would obviously produce the greater immediate return. The improvement of knowledge demands faith as well as dollars.

The Royal Society of London, in an eloquent preamble to its year book, points out to would-be benefactors that, in its considered opinion, more good is done, a greater end is served by endowments available for the general purpose of improving knowledge, than by funds devoted, or restricted, to specific objects. To take a few of the special needs of medicine at the present time, a knowledge of the meaning and nature of growth underlies all our attempts to deal with cancer; yet the study of growth as such is not the function of medicine, or of any handmaiden of medicine, but rather of the free sciences of zoology, physiology, biochemistry and biology in its widest sense. Again the effects of specific chemical substances, the relation between pharmacological action and chemical structure, require not an acquaintance with medicine or a pleasant bedside manner, not even a desire to benefit suffering humanity, but the highest form of chemical and biological skill. So long as medical students are the chief attendants on our courses, we are not really likely to forget the needs of medicine; but we should aspire rather to lead medicine along the paths of science than to push science along the paths of medicine.

The war was decided largely by the Grand Fleet. Yet how often was that fleet in action, what "good did it do," reckoning it crudely, how many Germans did it kill? Its functions were negative; it denied the sea to the enemy; it allowed the life of the nation and of its armies to operate behind a silent and invisible shield. Such, I often think, is one rôle of physiology in medicine. Medicine has a difficult and

urgent task, a task which brooks no delay. One function of physiology is to keep the seas clear and free for that task. There are quackeries enough. To-day in London there are qualified medical practitioners earning a large income, exploiting the credulity of sick people, by using the childish box of tricks associated with the name of Abrams. There are many other such types of fraud. You know them just as well as we do. Without a scientific education how can a medical practitioner deduce that a potency of 50 in a homeopathic medicine represents a concentration of one molecule in about 100,000 visible universes! Common sense may be a safeguard from the cruder frauds and quackeries, but clothe them in a flowery garb of science and without science your medical practitioner will be deceived. I like to tell my students, at the beginning of their course, that by learning to think physiologically in terms of what is known, rather than of what might be the case in another world, they are avoiding the pitfalls, both of belief and unbelief which would otherwise beset them. This is one rôle of physiology, a rôle possible only if physiology remains, not a handmaiden to medicine, but an independent interpreter of science, an intellectual discipline of free man in touch with science, equipped with all the tools of science, ready always to attack scientific fraud or to approve scientific discovery in any of the medical subjects. Your medical profession, no less than ours, needs a police force to guard it from quasi-scientific hypocrisy and fraud.

There is a further reason, in your country especially, why physiology should have its roots in science rather than in medicine, and that lies in the great facilities offered, in your full time medical units, for laboratory research. The applied physiology, the medical physiology, can be done in the medical units: all the more reason for encouraging your university laboratories to pursue their scientific problems.

If then, physiology is to be primarily an independent science and not a servitor of medicine, certain necessary consequences must follow. Its professors and teachers must be scientists, trained and qualified in science, not necessarily in medicine. At present many of them are qualified rather in medicine than in science. In many countries the only pathway to physiology is the long and troublesome one which leads a student to a medical degree: little wonder that the ablest intellects are often sidetracked in the sciences, physics, chemistry and biology, which make no such demand on their disciples. Pasteur was a chemist, Bayliss was catholic in his science, but had no medical degree. Barcroft, Langley, Hardy, Mines and Lucas (to name a few from the school of physiology at Cambridge) came to physiology through gates other than those of medicine. Most of these would have refused to enter had there been no other gate. Physiology can ill afford to lose such recruits.

Physiology then must have its roots in science, must attract students who have no intention of pursuing medicine as a profession. In this respect our science labors under one fundamental difficulty; it is an intermediate science, physics, chemistry and biology must precede it, and quite naturally the ablest students are filtered off and retained by the teachers in those other sciences. At Cambridge the schools of physics and applied mathematics, by their old established fame, attract the cream of the scientific ability of the country. That ability is often enough not specialized in one subject, but general. It happens to be devoted to physical science—it might equally have been devoted to physiological. I often think, with envy, of what would be done in physiology could we have a selection, for ten years, of the best brains which enter the Cavendish Laboratory at Cambridge!

This difficulty is not insuperable. At present there is a tendency to specialize too young. Students come from our schools with little general education, perhaps with a smattering of chemistry and physics, and proceed to specialize at once. It should be impossible for students of science absolutely to neglect the study of physics, chemistry and applied mathematics, as at present sometimes they do; it should be equally impossible for them to neglect the study of at least one biological subject, as they usually do. If only that principle could be conceded, we physiologists would get a fairer share of the good brains available. At present they tend to be monopolized by the simpler and more elementary sciences of chemistry and physics.

There is one institution in Britain which you do not possess here, which might perhaps be a great help to you in peopling your great and growing departments; that is the instruction of a certain number of "honor students" in the medical sciences. In England no department of physiology feels that it is "doing its job" unless it has a certain small proportion of its ablest students spending an extra year, or more, in studying advanced physiology, biochemistry or pathology after the completion of their ordinary course. These students may be medical students, who are spending a year or two by the roadside, during their medical training, in order to appreciate their science more fully and to learn how research is done; or they may (as is often the case at Cambridge) be students of science only, who are studying physiology or biochemistry purely as a science. These students are the most valuable element in our laboratories; they are the people from whom our research workers are made. For their work we give them an "honors degree" in science (B.A. or B.Sc.), which is an asset to them in their later career. There may arise cer-

tain administrative difficulties in the formation of such groups of science students in your schools; difficulties, however, can be overcome, and with the great and growing need of scientific workers for the great departments which are being organized all over your country, you might be well advised to consider the adoption of some such system.

The Present Tendencies of Physiology: Biochemistry

Physiology has two chief aspects, the biological and the physical. On the one side the fundamental problem is reproduction, growth, repair; on the other side mechanism, manner of working. Those two aspects require at present different methods of approach, different tools, though ultimately their tools and methods will be recognized as common. There has, of recent years, been perhaps an overemphasis of the physical aspects of the science; that, you may think, sounds strange from me, but J. S. Haldane, who knows me better, abuses me sometimes for being a "vitalist." The physiology of reproduction, of tissue growth, has been largely neglected, both in teaching and research, in many laboratories. That must change, and we must insist on the physiology of growth as being no less essential than the physiology of mechanism. This will depend upon a fuller cooperation with biologists and upon a recognition by botanists and zoologists of the wider scope of a physiological technique.

The first and most striking tendency of physiology to-day is the adoption of chemical methods of analysis. Indeed, some of the most progressive and enlightened chemists see the future developments of organic chemistry, partly in the realm of physical, but largely in that of biochemistry. In the past biochemistry has dealt with comparatively simple problems, mainly with the analysis of the material of which the cell is composed after it has been killed—chemical anatomy, so to speak. It has analyzed and tabulated the in-goings and the out-goings of the body. A living creature, however, is an event, or a series of events, in time as well as space, and the sequence and interplay of those events provide a far more complex problem than that of the nature of the background against which they happen to be played. Just as anatomy is seeking new methods, is beginning to pursue its studies by experiments on the living, rather than by observation of the dead, so biochemistry is passing on, beyond the simple organic chemistry of the structure of the matter which was once alive and is studying the events which occur in the actual living cell. Modern physics is getting inside the structure of the atom, chemistry inside the structure of the molecule; so anatomy—in some places—is attempting to find principles inside the visible structure of the tissue, and biochemistry inside the visible structure of the cell.

Biochemistry differs from physiology proper in using chemical methods of analysis. The older type of organic chemistry is not sufficient. Biochemistry is concerned, not principally with the bodies taken in or given out, not mainly with the structure of the background of the play, but rather with the sequence of events which actually occur in front of it. The chemist in his test-tube works with countless millions of molecules, all acting in the same way; the biochemist, on the other hand, deals with a mechanism in which molecules may pass, one at a time, through a living machine. He needs a finer means of analysis than classical organic chemistry can provide. It is necessary for him to get inside the mechanism and to dissect it by an ultrachemical technique. In so doing he must try to develop a special kind of chemistry, something finer and more subtle than the statistical methods of the chemical laboratory. He needs, moreover, to study the effects of factors such as diffusion, surface tension, interfacial forces, which on the large scale exert only a relatively small effect, but in bodies of the minute dimensions of the mechanism of the living cell assume a preponderant importance. To take an analogy, the velocity of movement of a big wave is little influenced by surface tension, while in the velocity of propagation of a ripple, surface tension is the determining factor. Similarly in a test-tube diffusion is relatively slow; in a blood corpuscle, owing to its dimensions, very rapid. Chemists have studied the kinetics of reactions in order to arrive at the laws of chemical dynamics. Biochemists, however, need to study them because of their actual incidence and importance in the events of life; and often biochemists, for this reason, find themselves compelled to develop a technique of their own, and in so doing may make advances of considerable interest in general chemistry and science. The recent and brilliant work of Hartridge and Roughton has brought the study of the time-course of the reactions of hemoglobin with gases—reactions which occupy only a few hundredths of a second—under direct experimental observations. Their methods can be applied to the investigation of other rapid chemical reactions. Warburg, studying the synthesis of carbohydrate by green cells, has found the simple relation that, in all parts of the spectrum, four quanta of energy are absorbed in the storage of one molecule of CO_2; and the same investigator has brought cell oxidation into a new relation with surface forces and catalytic agents. Hopkins, and also Meyerhof, have gone some way in the description of the chemical mechanism by which, if not ferments themselves,

something very like them, works. The isolation of insulin, to be followed some day, one hopes, by its description as a chemical body and finally perhaps by its synthesis, opens up many new and mysterious problems regarding the chemical structure of carbohydrates and their synthesis and breakdown in the body. The specific and amazingly powerful action of the most minute quantities of the accessory food factors—the so-called "vitamins"—has impressed upon us the necessity for the finest experimental chemical and physical skill if we are to isolate them and possibly finally to synthesize them. The mechanism of immunity and its fantastic dependence on organized chemical structure emphasize the same fact. Biochemistry is becoming, and will probably remain, our chief highroad in the analysis of the behavior of the living mechanism.

There is one disastrous tendency at the present time, the separation of physiology from biochemistry. I am glad to agree that biochemistry is just as important as—more important than—classical physiology; a separate department, a separate professor, a separate staff may be desirable. But just as one may regret the ridiculous and dangerous nationalisms by which the political world is torn, so we may regret the divisions of space and contact which occur between physiologists and biochemists in many universities. Are A B C and D physiologists or biochemists? Is it necessary to make A go half a mile to use a chemical technique; B to go 100 yards to use a kymograph? or is it desired simply to duplicate departments of physiology?

If biochemistry is to remain our chief highroad our students must be given a rather special training in chemical methods. In the second examination for medical degrees in the University of London, there is a wise provision; a special examination in organic chemistry for all medical students. This chemistry is taught by biochemists. In these days, however, of hydrogen ions, of Donnan equilibria and colloid chemistry, a knowledge of organic chemistry is not enough; the elements of physical chemistry are equally important; and if ever we succeed, at University College, in attaining control of what we teach while groaning under that strange incubus the University of London, we shall have a special course in physical and organic chemistry, taught in the departments of physiology and biochemistry.

BIOPHYSICS

Differing from biochemistry only in technique, but not in purpose, as a means of analysis of the ultimate events, is the application of more purely physical methods. Physiology in the past has been very much influenced by and dependent upon the development of instruments, and owing to the special nature of their difficulties physiologists have often been responsible for considerable advances in the design of instruments. The string galvanometer of Einthoven, especially in its latest form, capable of registering electric oscillations of wireless frequency directly, and his recent methods of recording sounds (up to the high frequencies of a Galton whistle) simply by their direct action on a quartz fiber about four millionths of an inch in diameter, are examples of such advance. There are many other recent instances—the reversion spectroscope of Hartridge, the use of the cathode ray oscillograph by Gasser and Erlanger for recording the action current of nerve, the development of calorimetric and electric means of studying the energy exchanges of animals, the use of electrometric methods of measuring ionic concentrations, the investigation of membrane equilibria and surface forces—all these require a skilful adaptation of physical technique to our special biological problems. It is obvious that in the utilization of the methods, mental and material, of the physicist and the skilled designer of instruments, we are again on one of the mainroads to the future. Many problems of a physical nature remain to be solved; for example, the effect of X-rays on living cells remains at present a mystery; so do the electric change accompanying the excitation wave and the mechanism by which work is produced with the expenditure of chemical energy in the muscle. The actions of specific physical factors, *e.g.*, light, heat and touch, on the sense organs have scarcely begun to yield to investigation. In these respects we are only at the beginning of knowledge and we await further and finer physical methods of analysis.

If such physical methods are to be taught in a reasonable time, to our unfortunate and overburdened students, a certain preliminary education is necessary. Botany, as usually taught in a girl-school, according to the opinion of two very distinguished English botanists, is not a help but a hindrance to a future scientific career. There are few intellectual difficulties about girl-school botany. The most striking defect which the majority of students show is their complete incapacity to face and overcome for themselves an intellectual difficulty of any kind. They may be able to read and absorb like blotting paper; they may be able to reproduce results as accurately as a penny-in-the-slot machine; but give them a problem and they gaze at it blankly. It is unfortunate, for medicine will provide them later with problems enough. One cure for it, simple as it may seem and unpopular as it will be, is (I believe) to insist on the teaching of theoretical mechanics and mathematics in the schools.

Theoretical mechanics is the foundation of all experimental and natural philosophy. Without a theoretical knowledge of the elementary properties of matter, all natural philosophy is moonshine. Moreover, theoretical mechanics, in an elementary way, is a philosophy in itself; it has a kind of formal precision of proof and statement, it provides certain fundamental intellectual difficulties, and it is the basis of all the physics which our students must learn later. If a knowledge of theoretical mechanics were required before entry to a medical school, as it was made recently at Manchester, not only should we be spared the presence of a certain small proportion of students who are constitutionally incapable of exact thought, but the remainder of the students would be spared the difficulty of understanding physics without a proper intellectual basis. We should have taken the first step towards making our doctors scientists; of protecting them from Abrams and a horde of other quasi-scientific imposters.

"Experimental" Physiology

Side by side with these new direct paths toward the physical and chemical solution of our problems, there remains the old mainroad, a road which one can see no chance of physiologists wishing to discard, the road provided by the so-called experimental method. The word "experimental" is used in a special sense in physiology, as implying observations made upon live animals, or upon organs removed from live animals. It implies rather the analysis of the animal than the analysis of the cell; it is sometimes more akin to modern anatomy than to biochemistry. Many experiments which we wish to make in physiology can not unfortunately, at any rate at first, be made on man, and it is necessary to employ animals to attain a degree of analysis which is possible in no other way. There can be no doubt that a careful and cautious application of experimental technique must lead, and must continue to lead, to progress in our conception of the working of the body of the more complex organisms. Moreover, even from the point of view of studying the cell, there are certain advantages in working with highly differentiated cells, such as those of muscle, nerve or kidney, and so investigating cell-function in a purer form than in the Jack-of-all-trades provided by the unorganized, undifferentiated animal. This great mainroad will certainly remain an essential means to progress in physiology, though it has a not unimportant side-road leading to anatomy. The analysis of the living nervous system, of reflexes and reactions, can not be attained merely by a study of the isolated nerve; nor can it be reached only by experiment and observation on man; it requires experiments on live animals. So also the study of digestion requires such experiments—operative interference with animals, the means of isolating actual digestive juices, and the study of their production under various circumstances. So also kidney function, pancreatic function, endocrine function, cardiac function, all require experiments on animals. One can only hope that the criminal folly of anti-vivisection will not render such progress impossible in the future. You in this country have been wise; you have not yielded an inch to the false sentiment, the childish credulity, the wicked cruelty of anti-vivisection. We have yielded an inch and they want to make it an ell. Anti-vivisection in England has seriously hindered the merciful work of medical progress and education. Take my advice, the only advice I dare give you, and use the whole of your resources to prevent any such interference with your liberties.

Human Physiology

In spite of their necessity in the analysis, there are certain fundamental objections to and difficulties about experiments on animals, difficulties due to the fact that the animal is not a willing and conscious agent in the experiment, objections which can be avoided only by observations made on man. It is strange how often a physiological truth discovered on an animal may be developed and amplified, and its bearing more truly found, by attempting to work it out on man. Man has proved, for example, far the best subject for experiments on respiration and on the carriage of gases by the blood, and an excellent subject for the study of kidney, muscular, cardiac and metabolic function. Apart from observation of the behavior of man experimented upon by disease, it is often possible to subject a healthy man even to quite extreme conditions without lasting injury. Moreover, experiment on man has the great advantage that it often leads directly to the kind of application which is required in medicine. Experiment on man is a special craft requiring a special understanding and skill, and "human physiology," as it may be called, deserves an equal place in the list of those mainroads which are leading to the physiology of the future. The methods, of course, are those of biochemistry, of biophysics, of experimental physiology; but there is a special kind of art and knowledge required of those who wish to make experiments on themselves and their friends, the kind of skill that the athlete and the mountaineer must possess in realizing the limits to which it is wise and expedient to go. Experiments on animals have generally, for the sake of safety, to precede experiments on man; but until a truth which has been discovered, or hinted at, by other methods has been applied to man, it has not really, so to speak, attained its majority. This is the branch of physi-

ology specially applicable to medicine and there is need in our schools of a special place for human physiology.

This experiment on the teaching of human physiology is being made in England, and it is a delight and encouragement to find how extensively it is being made here too. At Manchester some four years ago, during the reorganization of the medical school, histology was transferred to the department of anatomy and physiology was subdivided into three subdepartments of chemical, experimental and human physiology. The last named subdepartment, under my colleague, Dr. F. W. Lamb, provided a most interesting experiment in the teaching of physiology. From the day when the students arrived in the department they were instructed in the art of making experiments on themselves and others. I shall long remember the pathetic sight, on the first afternoon of the session, when thirty or forty students would be struggling with a needle to extract blood from their own, or preferably from someone else's finger!

The number of experiments that can be performed is very large—the ordinary circulatory and respiratory phenomena of course can be exhibited, the properties of blood, the characteristics of muscular exercise, the facts of vision, hearing, touch and balance and the reflex mechanisms of the body. Sometimes indeed an unrehearsed incident may add to the instruction, as when an injection of adrenalin was given to a subject who proved to be suffering from hyperthyroidism.

A further object of the scheme was to induce the students to study the range of normality in presumably healthy people, by a collection of ordinary data from a large number of their fellows. There is nothing necessarily abnormal in a pulse rate of 40 or in a pulse rate of 90, in a resting man. It is so often assumed, because the average pulse rate is 78, that any wide divergence from 78 is "abnormal." The students were persuaded also to collect the data of observations made on themselves, in the hope that thereby they might be induced to see that, in their own bodies, they possess—immediately available—some of the finest experimental material. By such means they could be induced to "think physiologically" in terms of a healthy working organism, to acquire confidence in making experiments on themselves and others, a necessary preliminary to successful experiment (for all treatment should be regarded as experiment) on the sick.

It is not necessary—I should be ashamed—to excuse this human physiology on the grounds of expediency. Perhaps a generation ago such excuses would have been necessary. To-day the physiology which can be done on man is just as good and just as scientific physiology as can be done on a lower animal or upon an isolated organ. It is just as notable for the precision and beauty of its results.

The experiment made at Manchester was more than justified—it was a palpable success. It is an encouragement to find the success attending similar experiments in your schools. One had only to examine the note-books kept by the students (not by one or two, but by nearly all) of their course in human physiology—note books sometimes almost like text-books in their completeness—to realize that the course certainly had achieved its object of making the students think of physiology in terms of man, and of man in terms of physiology. One had only to talk to the students themselves about it. It is early yet to see its result on the younger generation of medical men in Manchester; but I may be forgiven for hoping that this course will prove one of the important factors which may make the medical education in that school second to none in Britain.

Some day we hope to adopt a similar course at University College; at present we are prevented from making this change (among others) by the examination system pertaining in the University of London. Medical students are overburdened people and if they can not be examined in a subject nothing short of a miracle will induce them to study it. At present, under an antiquated system, our students are examined in enormous numbers in another laboratory, often inadequately equipped, where little but the ancient rites pertaining to frog's muscles can be performed. Until we are able, under some more rational system, to examine our own students and to take account of their work throughout their course, it will not be possible to try this excellent experiment fully in London. I commend it, however, to those of you who are free agents.

Quite apart from direct physiological research on man, the study of instruments and methods applicable to man, their standardization, their description, their reduction to a routine, together with the setting up of standards of normality in man, are bound to prove of great advantage to medicine; and not only to medicine but to all those activities and arts where normal man is the object of study. Athletics, physical training, flying, working in submarines or coalmines, all require a knowledge of the physiology of man, as does also the study of conditions in factories. The observation of sick men in hospitals is not the best training for the study of normal man at work. It is necessary to build up a sound body of trained scientific opinion versed in the study of normal man, for such trained opinion is likely to prove of the greatest service, not merely to medicine, but in our ordinary social and industrial life. Haldane's

unsurpassed knowledge of the human physiology of respiration has often rendered immeasurable service to the nation in such activities as coal-mining or diving; and what is true of the human physiology of respiration is likely also to be true of many other normal human functions.

Experimental Biology

We have spoken hitherto of four well-defined tendencies. There is another, a fifth tendency, not so obvious in England, but more obvious in this country, which is just as certain, I think, to make itself felt. To me it seems obvious that in the future zoology must inevitably look to experimental methods to amplify its fields. Call it experimental biology, or general physiology, or what you like, it may not have its home in an institute of medical sciences, but it will be physiology none the less. Just as biochemistry is, or should be, good and scientific chemistry, even though it be not studied in an ordinary chemical laboratory, so zoologists may find themselves adopting a special type of physiology, applicable to their special problems; and this will be, or should be, good physiology. Hitherto zoology has been largely concerned with following out the implications of the theory of evolution mainly, if not exclusively, by observational and morphological methods. Botany, on the other hand, has long recognized a special branch of physiological botany. In this respect botanists perhaps have been fortunate, since we so-called physiologists have not stolen the most interesting side of their subject from them! Physiologists deal with the physiology of animals, but only occasionally with that of plants. We are often, however, very ignorant of zoology, and the study of animals and of animal cells from the comparative physiological and functional standpoint has been largely neglected. Simply from the point of view of expediency, that of finding more suitable animals and cells and functions for our study, it is urgently desirable that physiology should be in close touch with zoology. Quite apart from that, however, physiology has to offer, in its greater elasticity of technique, a whole new armory of weapons to the zoologist by which to pursue his own proper studies. It is obvious that the evolution and synthesis of function are of far greater interest and value than those merely of structure. One can look forward to the day when a closer and growing cooperation will exist between physiology and zoology, by which advance on such lines may be assured.

The Synthesis of Function

I have just spoken of the synthesis of function. Up to comparatively recently the tendency of physiology has been rather towards analysis, and some physiologists have tended to forget the existence of the animal as a complete organized whole. If analysis be necessary, so resynthesis is also necessary. Perhaps the study of zoology by physiological methods, or of human physiology, may help to correct this tendency. The physical and chemical analyses of a painting reveal nothing but paint and canvas; yet it is obvious that something besides paint and canvas go to make a picture. The pure chemist and the pure physicist are often singularly ignorant of biology. They can not fit the living creature into their scheme of things and they tend sometimes to hypnotize themselves into the belief that scientifically speaking no account need be taken of it. It is perhaps worth emphasizing, therefore, that until a physicist or a chemist has learned something about the way in which animals or cells evolve and grow and behave, he has missed a large part of the natural universe. It is true that biologists should have passed through the fire, should have been hardened by the exact sciences. A physiologist without such training is only half-educated, apt to be "woolly headed" and diffuse, unacquainted with the background against which the events of life are played. A physicist or chemist, however, who is totally ignorant of biological truth, unacquainted with the biological standpoint, is equally only half educated. If and when a student of the exact sciences comes to physiology, he can produce results of service only if he be ready to adopt for awhile another standpoint and to regard life from the biological aspect. For that reason, just as one should welcome any tendency for future students of biology to study rigorous theoretical mechanics at school, and physics and chemistry at their university, so one would welcome—if one met it—the converse tendency for all students of the so-called exact sciences to study for awhile at least one biological subject. The principles of biology are as certain as those of physics, the hypotheses are no more strained, the generalizations are just as great landmarks of human achievement; and as the study of the exact sciences may make a biologist less "woolly-headed," so a study of biology may make a physicist or a chemist less inclined to be too certain of the complete objective existence of all he sees, or thinks he sees, perhaps more humble and more liberal in face of the great mysteries of the universe.

Examinations

You will see that I make no small claims for physiology: unfortunate, however, the student who has to face an examination in all these aspects of the subject. He will have but little leisure—which will be a pity since medicine requires sane and healthy men, hardened indeed by work, but tempered

by play. In many professions or services one finds promotion by merit. In the faculty of arts, where there is no laboratory work, such promotion may be difficult. In a subject taught practically in a laboratory, by several teachers, with proper records kept in note-books and attendance-sheets, the difficulty may be discounted. The abolition of the present preposterous and inhuman system of continual preparation, for artificial and often external examinations, in favor of some better arrangement, would seem to be the only way of avoiding an overburdening of our unfortunate students. You are free in this country to develop your own institutions, to make what experiments you like. Progress in education, like progress in science, demands experiments; broad and courageous experiments unhampered by the objections of those who hate to make an extra effort.

ANATOMY

I have spoken so far only of positive tendencies. There are certain negative ones which are emphasized in the organization of University College and depend upon the future of anatomy in England. These tendencies are even more obvious in this country. By an accident in British science, histology—the microscopic study of the web structure of the living tissue—has been associated with physiology. Just as a physiologist needs to know at least a modicum of physics and chemistry, so he must (or should) have an equal knowledge of anatomy and histology. These sciences, however, are not his proper job, and it is no more disgraceful for a physiologist to be ignorant of the distribution of the cutaneous nerves to the hand than to know nothing about the physical chemistry of interfaces. Histology, logically and naturally, belongs to anatomy and outside Britain it has usually been taught and administered by anatomy. Manchester, University College and to some extent Guy's Hospital, are at present the only places in England where this is recognized, and although many still shake their heads over these dangerous doctrines, I feel convinced that the time is not far distant when their example will be followed, more or less universally, so far as administrative conditions allow. There are several advantages in the surrender of histology to anatomy, though there is little need to argue them here. First, the new type of physiologist is apt to be so busy about other things that he tends to give inadequate care and interest to histology. Secondly, the new type of anatomist, the type which physiologists are singularly fortunate to have as colleagues, is one who is more interested in the structure of the living body than in the dissection of the dead one. The anatomy of to-day and of the future, in its scope and its technique, will be much the same as classical experimental physiology. Anatomy, in its problem of the structural synthesis and analysis of the living body, is bound to use a physiological technique, and one form of that technique namely, histology, which logically seems to belong to anatomy in any case, it would appear wise and just to link formally with anatomy in our schools. In the past, owing to the fact that an experimental or operational technique has been employed in elucidating the structure of such organs as the central nervous system, these also have been subjects dealt with by physiologists. The object of their studies was often of an anatomical nature, and now that some anatomists are ready to employ experimental methods, it would seem natural to relegate this portion of anatomy also to their care and to retain in physiology only such parts as relate to the actual working functions of the nervous system. It is no more disgraceful for a physiologist not to be an adept at remembering the contortions of the tracts in the nervous system than to be unacquainted with the laws of chemical dynamics. This redistribution of duties and objectives is likely to react favorably on both sciences and especially in the common ground of neurology. The working out of a real and wholesome cooperation between anatomy and physiology is, I think, likely to prove another—and not the least significant—of the great mainroads towards the future state of our common subject.

ORGANIZATION

Such then are the tendencies of physiology; whither will they lead? It is not altogether easy to predict. Biochemistry will undoubtedly expand to embrace large branches of chemistry; human physiology will stretch out its tentacles into hygiene, physical training and the study of industrial conditions. Anatomy and zoology will embrace large branches of the older classical physiology. Neurology will join hands with anatomy on the one side, and with experimental and observational psychology on the other, in the study of animal behavior and reaction. Zoology, biochemistry and physical chemistry will cooperate in studying the factors underlying reproduction and growth. One trembles rather to think of it all. There would seem little chance of the pretensions of physiology being too small, the difficulty will be rather to keep them within a reasonable compass. As soon as the business of a department becomes too large, it tends to cramp individuality and initiative and to adopt the methods of bureaucracy.

You in this country with your enormous and growing departments of medical science can never feel the freedom which we used to enjoy in the great days at Cambridge (not indeed so long ago) when Barcroft worked behind a green baize curtain in the passage

and Hopkins, Lucas, Adrian and I lived together in a coal cellar; those days however have gone, for us as well as you: the war, and very necessary organization, have made them a thing of the past.

These groups of sciences are becoming in a small way like government departments, great and ugly and unwieldy things, but still necessary if the scientific community is to be served. The pleasant old days when a single man, a man like Michael Foster, could teach and lecture, write and be an authority on the whole subject, are going, if indeed they be not gone. The death of Bayliss, whom we mourn in London, has removed one of the last landmarks in that personal, individual aspect of our science. In our laboratory arrangements, in our teaching and research, in our literature, in our connections with workers in other laboratories and lands, we are becoming socialized, organized, administered. There would seem to be no alternative—it is better at any rate to be organized than to be disorganized. The chief objection, however, to organization and authority is the moral and intellectual effect which they may have upon those who use them. In a mass of detailed work a man may forget the more distant, but the real objects of his existence. It was very hard for the staff officer in the war to realize that he, in his administrative capacity, was the servant and not the master of the regimental officer. Authority, the habit of making arrangements and giving orders, lends a false impression of moral and intellectual superiority. The regimental officer in science is the man who is teaching, researching, advancing his subject. The professor, the head of the department, is useful as such only so far as he can be of service to him, can study his needs, and by the special sources of information and the special powers at his disposal, advise and help and coordinate his assistant's labors. This organization is inevitable, in larger or smaller units; we must recognize it frankly and submit to it; and one of the great questions of the future, especially perhaps for you with your faith in organization, is whether organization shall dry up the fountains of originality, or whether, with proper and reasonable precautions, originality and vitality can survive. Team work must be planned and made, but at the same time the opportunity must remain for that free and unfettered originality which our older and less business-like methods evoked. The good and business-like people, those whose childhood and youth were respectable and law-abiding and above reproach, fit so nicely into an organized scheme; yet the wicked and unbusiness-like—those whose childhood was a revolt against discipline and authority, whose manhood may be a fight against preconceived ideas and traditional errors or shortsight—are so often the ones whose gifts produce the real and material advance. In our arrangement of team work and of administrative control, in our centralization we must leave a place for the heedless person, who embarks on science as an adventure of the spirit. How can we do this? By demanding for physiology its proper place—a place as a science, a place in a philosophy of life. It is the vaguer things which claim the more adventurous minds. It is the adventurer who brings new facts and methods and hope to his more reasonable brothers. He may be wrong—he very often is—but he catalyzes the reactions of the rest, he produces reactions, where otherwise the energy may be large but the velocity is certainly small.

Discovery and Adventure

Scientists in the past have often been too ready to indulge in cheap philosophy. Life is not simply the motions of molecules, or even of atoms and electrons, governed merely by the laws of chance. No monist theology, such as that of Haeckel and Ostwald, in which God is replaced by Energy, gives us any new clue to the mysteries that pervade the universe. In science progress comes, as in everything, only by hard work, tempered by courageous imaginative thought. There are many difficult and fundamental problems to which physiology demands an answer. These are the problems which draw the finest intellects; to these problems we must continue to insist that physiology has a right. The age-long dispute between "vitalism" and "mechanism" may seem to serve no purpose. The unsolved problem of the complete applicability of mechanics and thermodynamics to all the processes of life may remain unsolved. The ultimate dependence of mind on nervous system, of specific biological character on specific chemical structure, may remain unproved. The paradox of apparently purposeful evolution, and the anomaly of useful adaptation, in an otherwise physical universe, may remain outside the scope of exact science. Yet all these things continue within the range of physiology and it is our duty to investigate them and our privilege to ponder over them. They add the rosy tint of adventure to the cold light of organized research. They may seem useless—many of the best things in life are "useless," in the sense that they produce no immediate return—but only so far as physiology insists on investigating, when it desires, apparently "useless" things, and so of entrapping those rarer intellects, which can catalyze the energies of the rest, only so far can physiology attain to new and unexpected truth and survive the weight which its necessary organization inevitably imposes.

The future compass of our subject, therefore, is the study of the mechanism of life in any form

and by every means and device which science offers. We shall need organization, we shall need team work, we shall need the resources of business-like methods and of competent leadership; we shall require the help of every art and science; and to some of them, especially to medicine, we shall count ourselves happy if in God's good time we can bring something in return. But more than all things we shall need, indeed we must insist on retaining, freedom; liberty to research on things because they are of interest, because their study and investigation are an adventure of the human spirit, because they would seem to lead towards a solution of those fundamental problems which man, in his intellectual impudence, believes to be soluble.

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ON THE CONTROL OF THE RAT POPULATION

ASSUMING that one pair of wild Norway rats begins to breed at four months of age and produces four litters at intervals of four months between litters, and that each litter consists of six young—three males and three females—and further assuming that all the pairs of young breed in a like manner through successive generations, Professor George Gailey Chambers, of the University of Pennsylvania, has computed that at the end of ten years from the birth of the original pair, the progeny would be represented, approximately, by the number 2.3×10^{18}. This is 2.3 times one million to the third power—a number itself well-nigh incomprehensible, though amusing to play with.

If, under the same conditions computation is again made—but this time only for three years—it appears that at the end of three years there would be some 516,000 individuals. Thus, while there were two rats at the beginning of the period, there would be at the end, over 500,000, and this in three years. Such results serve to show how rapid the increase might be.[1] For obvious reasons these computations, which purposely exclude all consideration of postnatal mortality, can not be controlled by direct observations.

Bearing on these computed results, there are, however, some laboratory records which are illuminating. In 1919 Miss Duhring, who is in charge of the albino rat colony at the Wistar Institute, obtained, in 16 months from the birth of the original pair, 3,800 individuals, all the descendants of one pair of albino rats. Moreover, this result was obtained, although after the first litter of the original pair—the pairs were not mated until they were four months of age and in the later months of the period—several hundred rats were not allowed to breed at all owing to lack of cage room.

Under the conditions given for our first instance only 512 Norway descendants were to be expected at the end of the first 16 months. These observations on the albino variety show, therefore, that the conditions set for the computation in the case of the Norway are conservative, since direct observation here gives a number of albinos more than seven times that computed for the Norway.

The high numbers for the albino rat were the result of large numbers of litters from a single pair: a shortening of the time between litters, frequently to 30 days or less—and large litters—many containing 15 or more individuals. The mortality was, of course, very low. The causes for these conditions leading to rapid increase were good food, the absence of external parasites; careful handling and some exercise in the revolving wheel. Among these influences the absence of parasites and the good food are of special importance.

We may estimate the rat population of the United States at present as 120 millions. This estimate is admittedly liberal.

Under the conditions given for our first instance this number, 120 millions, would be somewhat surpassed by the progeny of one pair in four years and four months.

The Norway rat has been in the United States for at least 150 years and since, after this long lapse of time, it is estimated to number only 120 millions, it has clearly failed to live up to its reproductive potentiality as computed, for to obtain 120 millions from one pair in 150 years would require doubling the population only every 5.8 years.

To explain this slow rate of increase as compared with that to be expected from the foregoing computations we must choose between a very high postnatal mortality and a greatly restricted reproduction. Without presenting a detailed argument we can, I think, fairly conclude that the difference depends mainly on the restricted reproduction. Under the conditions in which the wild Norway usually lives, the enormous numbers, as computed, are never born.

As recent laboratory studies show, it is by food that the rate of reproduction is largely controlled. Where suitable food is plentiful reproduction is active—a relation illustrated by the abundance of rats about granaries, slaughter houses, on the water front of

[1] Previous calculations of the reproductive powers of the rat—some of which give enormous numbers—are presented by James Silver, on page 66 of the *Journal of Mammalogy*, Vol. 5, No. 1, February, 1924.

seaports and recently in the trenches, as we shall long remember. The population in these localities is largely indigenous.

The present methods of control involve the organized killing of rats. Rat battues may, in a measure, remove rats from the selected localities, but killing a large fraction of the rat population in a given place increases the proportion of food available for the survivors and the albinos show what survivors can do when well fed.

In the view of the public interest in the reduction of the rat population I have ventured briefly to call attention to the relation of the food supply to the general problem, since a recognition of the relation will assist in making plans for the effective control of this animal.

HENRY H. DONALDSON

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SCIENTIFIC EVENTS

THE SOUTHAMPTON MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ARRANGEMENTS are in progress for the next annual meeting of the British Association, to be held in Southampton from August 26 to September 2, under the presidency of Dr. Horace Lamb, formerly professor of mathematics in the University of Manchester. Presidents of the several sections have been appointed as follows: *mathematics and physics,* Dr. G. C. Simpson, director of the Meteorological Office; *chemistry,* Dr. C. H. Desch, professor of metallurgy in the University of Sheffield; *geology,* Professor W. A. Parks, of the University of Toronto; *zoology,* Mr. C. Tate Regan, keeper of zoology in the British Museum (Natural History); *geography,* Mr. A. R. Hinks, secretary of the Royal Geographical Society; *economics,* Miss Lynda Grier, principal of Lady Margaret Hall, Oxford; *engineering,* Sir Archibald Denny; *anthropology,* Dr. Thomas Ashby, director of the British School at Rome; *physiology,* Dr. A. V. Hill, professor of physiology in University College, London; *psychology,* Dr. C. E. Spearman, Grote professor of the philosophy of mind, University of London; *botany,* Professor J. Lloyd Williams, of University College, Aberystwyth; *education,* Dr. W. W. Vaughan, headmaster of Rugby; *agriculture,* Dr. J. B. Orr, head of the Rowett Research Institute, Aberdeen. Among the principal items already set down for discussion are transport problems, to which the sections of economics and engineering will devote two days, with special reference to the railway centenary of the present year; the cost of farming and the marketing of agricultural produce (sections of economics and agriculture); the functional significance of size (zoology and physiology); the ignition of gases (chemistry and engineering); tidal lands (geography and botany); variations in gravitational force and direction (physics and geology); recent investigations upon vocational guidance (psychology and education); the distribution of animals and plants in relation to continental movements (geology, zoology and geography); the acquisition of muscular skill (physiology and psychology), and discussions on health in schools, the disciplinary value of subjects, the training of teachers and the teaching of biology. Professor Parks, of Toronto, as president of the geological section, succeeds the late Dr. Willet G. Miller, the Ontario government mineralogist, who was to have occupied the chair of the section.

LEGISLATION RELATING TO THE SCIENTIFIC WORK OF THE GOVERNMENT

A BILL providing for a medal of honor and awards to government employes for distinguished work in science, the plan for which was originated some time ago by Dr. E. Lester Jones, director of the United States Coast and Geodetic Survey, was introduced into the house of representatives on February 19. The bill, which follows, was referred to the committee on the library:

Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that the president of the United States is hereby authorized to present, in the name of congress, a medal of honor and written testimonial to scientific workers of the federal government whose labors have contributed to the advancement of scientific knowledge or applied its truths in a practical way for the welfare of the human race.

SECTION 2. The official designation of the medal shall be the Jefferson Medal of Honor for Distinguished Work in Science.

SECTION 3. That recommendations to the president of persons to be considered for the honor contemplated in this act shall be made by a commission of three persons, consisting of one representative each from the National Academy of Sciences, the American Association for the Advancement of Sciences and the American Engineering Council, who shall serve without salary.

SECTION 4. That not more than five scientific workers shall receive the medal in any one year and that the persons so honored shall receive the sum of $100 on the presentation of the medal and testimonial and thereafter, annually for life, a sum of money the amount of which shall be fixed by the commission making the award; said sum to be not less than $100 and not more than $500 per annum, which said sum shall be exclusive of salary or pension.

SECTION 5. There is hereby authorized an appropriation of $1,500 to defray the expenses of securing a suit-

able design for the medal and providing said medals, testimonials and awards for the first year; and thereafter there is hereby authorized an annual appropriation, for the purposes herein provided, not exceeding $2,500.

SECTION 6. This act shall take effect immediately.

The following two bills, the first of which provides for the completion of the topographical survey of the United States and the second authorizes the coast and geodetic survey to make seismological investigations, have been passed by both branches of the congress and signed by the president:

Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that the president be, and hereby is, authorized to complete, within a period of twenty years from the date of the passage of this act, a general utility topographical survey of the territory of the United States, including adequate horizontal and vertical control and the securing of such topographic and hydrographic data as may be required for this purpose, and the preparation and publication of the resulting maps and data: *Provided,* that in carrying out the provisions of this act the president is authorized to utilize the services and facilities of such agency or agencies of the government as now exist, or may hereafter be created and to allot to them (in addition to and not in substitution for other funds available to such agencies under other appropriations or from other sources) funds from the appropriation herein authorized or from such appropriation or appropriations as may hereafter be made for the purpose of this act.

SECTION 2. That the agencies which may be engaged in carrying out the provisions of this act are authorized to enter into cooperative agreements with and to receive funds made available by any state or civic subdivision for the purpose of expediting the completion of the mapping within its borders.

SECTION 3. The sum of $950,000 is hereby authorized to be appropriated out of any moneys in the treasury not otherwise appropriated, to be available until the 30th day of June, 1926, for the purpose of carrying out the provisions of this act, both in the District of Columbia and elsewhere as the president may deem essential and proper.

Be it enacted by the senate and house of representatives of the United States of America in congress assembled, that the Coast and Geodetic Survey is hereby authorized to make investigations and reports in seismology, including such investigations as have been heretofore performed by the Weather Bureau.

FOREST RESEARCH COUNCILS

MANUFACTURERS in wood-using industries, business and professional men, foresters and deans of forest schools met at Asheville, February 12 and 13, as members of the new Appalachian Forest Research Council, appointed by the Secretary of Agriculture to cooperate with the Appalachian Forest Experiment Station of the United States Forest Service. The two days' sessions were devoted to making the new councillors thoroughly acquainted with the work of the Experiment Station, and to a discussion of future activities of both bodies. W. D. Tyler, of the Clinchfield Coal Corporation, Dante, Va., acted as chairman of the meetings.

Resolutions were unanimously passed supporting state and federal action toward forest tax adjustment, state forestry, fire protection, utilization of the great quantity of timber already killed or threatened by the chestnut blight and cooperation with the Appalachian Forest Experiment Station.

With the Appalachian council the secretary of agriculture has now appointed three research councils to function in cooperation with forest service experiment stations in important timber regions of the country, the others being in the Lake States and in the Northeast. It is understood that plans are already under way for similar councils to be appointed for the southern pine region and for the Pacific Northwest. These are announced as part of a comprehensive plan to bring out the practical features of research work in forestry and to keep the foresters in close touch with the needs of the regions their experiment stations serve most intimately.

Membership of the council includes John Raine, president, Meadow River Lumber Co., Rainelle, W. Va.; Dr. G. R. Lyman, dean, West Virginia College of Agriculture; James F. Lakin, president, West Virginia State Board of Control; T. H. Clagett, Bluefield, W. Va.; A. B. Brooks, chief game protector, W. Va.; Dean T. P. Cooper, Kentucky Agricultural College; Tennessee State Forester R. S. Maddox; S. F. Horn, editor, *Southern Lumberman;* George L. Wood, General Manager R. E. Wood Lumber Co., Baltimore, Md.; John H. Hassinger, Abingdon, Va.; State Forester Chapin Jones, Virginia; Andrew Gennett, president, Gennett Lumber Co.; R. B. Robertson, president, Champion Fibre Co.; C. C. Smoot, III, North Wilkesboro, N. C.; John Cecil, Biltmore Estate; North Carolina State Forester J. S. Holmes; Dean B. W. Kilgore, of North Carolina Agricultural College; Col. J. H. Pratt, Asheville, N. C.; G. A. Cardwell, Atlantic Coast Line R. R. Co., and Bonnell H. Stone, president, Georgia Forestry Association.

AWARDS FORM THE MILTON FUND AT HARVARD UNIVERSITY

ANNOUNCEMENT is made at Harvard University of twenty-one awards to professors in the university in accordance with the provisions of the Milton Fund for research. As noted in SCIENCE for October 3, 1924, this legacy, yielding an annual income of about $50,-000, was received by Harvard University last spring. The awards include the following for scientific work:

Gregory Paul Baxter, professor of chemistry; for one year, to assist in investigations upon the density of gases, important in finding atomic weights of the inert gases.

Frederick Albert Saunders, professor of physics; for one year, to purchase a spectrograph of large size with optical parts made of quartz for use in the Jefferson Physical Laboratory in researches dealing with the spectra of atoms and molecules.

James Bryant Conant, assistant professor of chemistry; for two years, to aid in his investigations of the chemistry of hemoglobin in the border-line field between organic, biological and electro-chemistry: part for a trained assistant, part for laboratory expenses and part for the purchase of a spectro-photometer.

Harlow Shapley, Paine professor of practical astronomy and director of the Harvard College Observatory; for one year, to enable him to continue his study of the stars: part for a slit spectroscope to be attached to the 24-inch Bruce refractor at Arequipa, Peru, for use in connection with the study of the velocities of the bright line nebulae in the Magellanic clouds and the Southern Milky Way and part for the construction of a slit spectroscope as accessory to the 60-inch reflector at the Cambridge station of the Harvard Observatory, to be used for analysis of the chemical constitution of the brighter northern stars and for the determination of their radial velocities.

Alexander George McAdie, Abbott Lawrence Rotch professor of meteorology and director of the Blue Hill Observatory; for one year, to provide necessary equipment and services of an expert mechanic to permit Professor McAdie to make at Blue Hill Observatory researches upon the general problem of the dust content of free air and the special problem of the behavior of water vapor in free air during thunderstorms, which are part of a general study of atmospheric pollution.

Carroll Cornelius Pratt, instructor in psychology; for one year, to purchase a set of Stern tone variators to be used as a source of pure tones of definitely known frequency which can be varied over a wide range in an investigation of tonal intervals to determine whether the perception of a series of tones follows the Weber-Fechner law.

Emory Leon Chaffee, associate professor of physics; for one year, for apparatus and an assistant to conduct investigations on variations in electrical potential in the retina of the eye resulting from stimulation by light.

William Duane, professor of bio-physics; for two years, to carry on researches on X-rays and radio activity: part for the completion of a 100,000-volt storage battery, part for an assistant and the purchase of equipment and materials.

Edward W. Forbes, director of William Hayes Fogg Art Museum; for one year, to study the chemistry of paints and the preservation of pictures and investigation of the possible use of X-ray work in the detection of picture forgeries.

Grinnell Jones, associate professor of chemistry; for one year, for apparatus required in research on the electrical conductivity of solutions.

Merritt Lyndon Fernald, Fisher professor of natural history; for one year, for field work in connection with the geographic botany of Northeast America, notably in Newfoundland and Labrador.

Edward Charles Jeffrey, professor of plant morphology; for one year, for traveling and field expenses in Australia and New Zealand incident to a research on the trees of the southern hemisphere.

William McDougall, professor of psychology; for two years, to continue his research on the Lamarckian hypothesis of the transmission of "acquired characters."

SCIENTIFIC NOTES AND NEWS

Dr. Roland Thaxter, professor emeritus of botany at Harvard University, has been elected a foreign member of the French Academy of Sciences, section of botany.

It is reported that the council of the British Association for the Advancement of Science has elected the Prince of Wales president for the 1926 meeting in Oxford.

Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, has been elected corresponding member of the Sociedad Medica de Caracas, Venezuela.

The Franklin Institute recently awarded to Dr. Harvey C. Hayes, of the Naval Research Laboratory, Anacostia, D. C., its Louis Edward Levy gold medal for his paper on "Measuring ocean depths by acoustical methods," printed in the *Journal* of the Franklin Institute for March, 1924.

The American minister to Denmark presented to Knud Rasmussen, the Danish Arctic explorer, the Daly medal of the American Geographical Society on March 10.

The president and council of the Royal Society decided at a meeting on February 19 to recommend for election into the society the following fifteen candidates: Dr. W. R. G. Atkins, Professor C. A. Lovatt Evans, Mr. R. H. Fowler, Dr. F. A. Freeth, Dr. Walcot Gibson, Dr. Harold Jeffreys, Professor F. Wood Jones, Professor J. Kenner, Professor E. Mellanby, Mr. J. A. Murray, Professor J. Proudman, Mr. R. V. Southwell, Dr. L. J. Spencer, Dr. R. J. Tillyard, Professor R. Whiddington.

Dr. Karl A. L. Kock has been chosen to fill the place of corresponding member of the Swedish Academy left vacant by the death of Dr. Söderwall.

Dr. Friedrich Paschen, who was recently appointed president of the Physikalisch-Technische Reichsanstalt, has been elected to an honorary professorship in the faculty of the University of Berlin.

Dean Louis Mitchell, of the College of Applied

Science, Syracuse University, has been appointed a member of the grade-crossing commission to succeed Alexander T. Brown, who has resigned.

DR. WILDER D. BANCROFT, professor of physical chemistry at Cornell University, has been nominated for the Harvard College Board of Overseers to be elected for a term of five years beginning next June.

DR. HOWARD CANNING TAYLOR, professor of clinical gynecology at the College of Physicians and Surgeons, New York, has been elected president of the American Society for the Control of Cancer.

DR. CHARLES D. WOODS has resigned his position of director of the division of information of the Massachusetts Department of Agriculture on account of ill health. His permanent residence will be at Ellsworth, Maine.

SIR ARNOLD THEILER, director of veterinary research in the South African Department of Agriculture, has placed his resignation in the hands of the Union Government.

DR. ALFONS KUNZ, assistant during the past two years to Professor Geza Zemplén, of the chemistry department of the Technical University of Budapest, Hungary, has been appointed a research associate in the polarimetric section of the United States Bureau of Standards.

CAPTAIN OTTO SVERDRUP, Norwegian explorer, has consented to conduct the French Arctic expedition's ship to Franz Josef's Land. The expedition, under Lieutenant Jules de Payer, will probably start this summer and will be gone a year. Airplanes will be used, and it is possible an attempt will be made to reach the pole, but the main objects of the expedition are scientific.

A GEOLOGICAL survey party in charge of Gerald Fitzgerald, topographer, and Walter R. Smith, geologist, has departed from Seattle for northern Alaska, to continue the exploration of Naval Petroleum Reserve No. 4. They plan to explore a region between the head of the Pitmegea and Utukok Rivers.

DR. AUSTIN M. PATTERSON, professor of chemistry at Antioch College, will sail for Europe on April 16 to attend meetings of the International Committee on Organic Chemical Nomenclature, of which he is the American member. He also expects to attend the chemical congress to be held in Bucharest in June.

DR. EPHRAIM HARENBENI, former botanical advisor of the Palestine government and for many years a student of the flora of Palestine, is visiting the United States.

PROFESSOR W. F. G. SWANN, of the Sloane Physical Laboratory of Yale University, gave a lecture on "The principle of relativity" on March 12, at the Franklin Institute.

DR. DONALD D. VAN SLYKE, research chemist of the Rockefeller Institute, will give three lectures at Rutgers University, in April, on the general subject of "The chemistry of the blood."

PROFESSOR P. DEBYE, of Zürich, delivered an address on "The quantum theory and its bearing on the classical laws of the conservation of energy and momentum," before a meeting of the Philosophical Society of Washington, on March 11.

DR. ROLLIN T. CHAMBERLIN, professor of geology at the University of Chicago, gave an illustrated lecture before the Geographic Society of Chicago on March 13, on "Exploring the cariboos."

ARTHUR W. THOMAS, associate professor of food chemistry at Columbia University, addressed the New York Academy of Medicine on the subject, "Modern colloid chemistry," on February 5.

DR. LOUIS D. RICKETTS delivered the fourth Brackett lecture at Princeton University on January 20, taking as his subject the "Progress in copper metallurgy."

ON February 21, Professor L. V. King, F.R.S., of McGill University, delivered an address to the Royal Canadian Institute of Toronto, on the subject "Recent Canadian researches on aids to navigation." On February 28, Dr. Zay Jeffries, director of Research Aluminum Company of America, Cleveland, delivered an address to the institute on "The hardness of metals, what it means and how it is produced."

PROFESSOR JOHN FILLMORE HAYFORD, director of the college of engineering at Northwestern University, died on March 10, aged fifty-seven years.

DR. WILLIAM MCINNES, former director of the Geological Survey of Canada and director of the Victoria Museum, Ottawa, died on March 11, aged sixty-seven years.

WILLIAM WATSON, formerly curator of the Royal Botanic Gardens, Kew, England, died on January 30, aged sixty-seven years.

DR. O. LARCHER, of Paris, former vice-president of the Société de Biologie, has died, aged eighty-one years.

DR. LEO TESTUT, professor of anatomy at the University of Lyons and member of the French Academy of Medicine, has died at the age of seventy-six years.

THE United States Civil Service Commission announces an unassembled examination for "biologist" in the U. S. Bureau of Fisheries. The subjects to

be considered are (1) Education, training and experience, weights 70; (2) publications or thesis (to be filed with application) weights 30. There are to be filled from this examination a vacancy in the position of director of biological station, Bureau of Fisheries, for duty at Key West, Florida, at $3,800 a year and vacancies occurring in positions requiring similar qualifications throughout the United States, at this or higher or lower salaries, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion. Receipt of applications will close on April 7.

A series of public lectures were given at the Carnegie Institute of Technology during March, 1925, as follows: Two lectures were given by Dr. James F. Norris, president of the American Chemical Society and professor of organic chemistry at Massachusetts Institute of Technology, who discussed "The reactivity of atoms and groups in organic compounds," on the evenings of March 9 and 10. On the evenings of March 12, 13 and 14, a series was given by Dr. Carl Benedicks, director of the Metallographic Institute of Stockholm, Sweden. His subjects were as follows: "On the theory of high speed steel;" "A determination of the specific gravity of moltom iron —a rational moulding form for alloys difficult to roll;" and "Homogeneous thermo-electric and homogeneous electro-thermic effects." The third series was given on March 16, 17, and 18, when Dr. Karl K. Darrow, physicist with the Bell Telephone Laboratories, Inc., of New York City, talked on "Atoms and radiation."

A number of eminent geographers in the United States and Europe are giving lectures at Clark University. Dr. Edward L. Stevenson, former director of the Hispanic Society and professor of history at Rutgers, spoke on "Early discovery and exploration in the New World as represented by contemporary map makers," on March 2. Dr. Henry C. Cowles, professor of botany at the University of Chicago, delivered a series of six addresses on "Plant ecology" and on "Ecology in the settlement of boundary disputes," illustrated by slides. The third lecturer will be Professor George B. Roorback, member of the faculty of the Harvard Graduate School of Business Administration, who will speak on "Problems in foreign trade," on the afternoons of March 10, 13, 17, 27 and 31. Dr. Frans X. Schaffer, professor of geology and director of the Natural History Museum of Vienna, will have for his subject, "Man in the stone age in the high Alps," in three lectures to be given April 1 and 2. On the afternoon of April 8, he will talk on "Changes of the earth's crust," and on the evening of the same day on "Seven travels in Asia Minor." Dr. William C. Alden, of the United States Geological Survey, speaks on May 15 and 16, on "Physical features of central Massachusetts," and will also give an illustrated talk on the Glacier National Park.

The thirteenth annual meeting of the Eugenics Research Association will be held at Cold Spring Harbor on June 27, 1925. The subject of Dr. Charles W. Burr's presidential address for that date is "The changed attitude of psychiatry toward crime." Besides the presidential address, there will be a number of other scientific papers, committee reports, business meeting and luncheon. Persons who attend the meeting can leave Pennsylvania Station, New York, at about 9 A.M., and returning can reach Pennsylvania Station at about six in the evening. Members with eugenical researches to report this year are respectfully requested to establish early contact with the program committee by addressing the Secretary of the Eugenics Research Association, Cold Spring Harbor, Long Island, N. Y.

The fourth annual Congress of Anesthetists will be held at The Breakers, Atlantic City, from May 25 to 28, during American Medical Association week, under the presidency of Dr. Wesley Bourne, of Montreal. Special sessions will be devoted to current researches, newer anesthetics, effects on respiration and circulation, blood and tissue chemistry, tests for evaluating risk and handling hazardous patients.

The next meeting of the International Commission of Eugenics will be held in London on July 14 and 15. Agenda for the sessions and communications should be sent to the secretary, Dr. A. Govaerts, of Brussels.

The Sixth International Neo-Malthusian and Birth Control Conference will be held at the Hotel McAlpin, New York, from March 25 to 31, under the presidency of C. V. Drysdale, London. Among those scheduled to speak are: Dr. Adolph Meyer, of Johns Hopkins University; Dr. Raymond Pearl, of Johns Hopkins University; Dr. Edward M. East, Harvard University; Dr. Leon J. Cole, University of Wisconsin, and Dr. Clarence C. Little, president of the University of Maine. The previous international conferences were held in Paris, 1901; Liége, 1905; The Hague, 1910; Dresden, 1911, and London, 1922.

The Sigma Xi Alumni Association, of the University of Pittsburgh, held a meeting on March 16 in Thaw Hall. A program was presented by the staff of the department of physics as follows: Dr. L. P. Sieg, "The optical constants of crystals"; Dr. O. H. Blackwood, "The nature of gas ions"; Dr. W. N. St. Peter, "Infra red line spectra"; Dr. J. J. Weigle, "Electrons in metals"; Dr. Richard Hamer, "A recent

addition to the quantum theory of the photo-electric effect."

A SCIENCE club, including in its membership the faculties and advanced students of the four science departments, has been formed at St. Lawrence University, Canton, N. Y. The organization meeting was held on December 8, 1924. John B. Hulse is secretary.

A GRANT of $200 has been awarded to Dr. Charles E. Simon, of the department of filterable viruses of the School of Hygiene of the Johns Hopkins University, by the committee on scientific research of the American Medical Association for the prosecution of his studies on measles.

THE Rockefeller Institute for Medical Research is to erect a two-story isolation building which will cost $125,000.

THE late J. M. G. Prophit, a British merchant, has left the residue of his estate, estimated at £160,000, for a trust fund of which one half is to be applied for inquiry into the nature, cause, prevention, treatment and cure of tuberculosis, and one half for similar inquiry regarding cancer, as a board of special trustees shall decide. The trustees may, among other powers, apply the funds of the trust in financing persons or institutions conducting such research, the equipment and endowment of institutions or laboratories for this purpose and the publication of the results of such researches.

A NUMBER of centers of scientific research in France are to receive funds from the nine million francs collected from the public on Pasteur's day. Recommendations for the division of the funds, by the French Academy, have been made as follows: Observatories of France and Algeria, 150,000 francs; zoological laboratories, 630,000 francs; laboratories of physiology and medicine, 576,000 francs; Mme. Curie's laboratory in the Sorbonne, 170,000 francs; French Institute at Beyrout, 300,000 francs; M. König's laboratory, 200,000 francs; industrial science centers, 510,000 francs, and the work carried on by Henri Poincaré, mathematician, 120,000 francs.

COLUMBIA UNIVERSITY will hereafter take over patents arising from discoveries made in its own laboratories. Adoption of this policy is a new departure in the Columbia administrative system, which will protect the inventor and the public and enable the university, by sharing in profits, to promote research. An administrative board of university patents has been established.

THE Friends of Medical Progress, a national lay organization incorporated in Boston, Massachusetts, in 1923 for the purpose of disseminating medical knowledge among the general public, is contemplating for the year 1925 a greatly extended program of service. Office headquarters, formerly located in Boston, have moved to New York City, 370 Seventh Avenue, where cooperation with the more important educational and health organizations will be facilitated. With the change in location also comes a change in name. The society will hereafter be called the American Association for Medical Progress. Mr. Benjamin C. Gruenberg, well known to workers in the fields of education and public health, will take over the active management of the organization.

UNIVERSITY AND EDUCATIONAL NOTES

JOHN D. ROCKEFELLER, JR., has contributed the sum of $1,000,000 towards the $5,000,000 endowment fund being raised by the Tuskegee and Hampton Institutes.

OVER $10,000,000 has been pledged to Northwestern University since the beginning of its endowment campaign in 1920.

A BILL authorizing the expenditure of $370,000 for a medical school building at Howard University, Washington, has been favorably reported from the Senate Committee on public buildings and grounds.

RAFAEL PALMA, a Filipino lawyer, has been elected president of the University of the Philippine Islands.

PROFESSOR L. P. SIEG, head of the department of physics at the University of Pittsburgh, has been appointed dean of the college of liberal arts of the university.

PROFESSOR S. D. SNADER, formerly professor of structural engineering in South Dakota State College, has been appointed professor of structural engineering at the Stevens Institute of Technology, in the place of Frank E. Hermanns, who resigned to give his entire time to his private practice.

DR. GEORGE ALFRED GARRATT, who has been for the past two years in charge of the department of forestry and engineering at the University of the South, Tennessee, has been appointed assistant professor of forest products in the School of Forestry at Yale University.

PAUL D. KELLETER, formerly director of purchases and sales, United States Department of Agriculture, has been appointed director of the extension department of the New York State College of Forestry at Syracuse University. Mr. Kelleter succeeds Mr. Earl S. Peirce, resigned.

B. J. RYRIE has resigned his lectureship in morbid anatomy and histology at the University of Manchester, on his appointment to the Wernher Beit chair of pathology in the University of Cape Town.

DR. W. HIEBER, of Würzburg, has been appointed director of the department of inorganic chemistry at the University of Jena.

DISCUSSION AND CORRESPONDENCE

SHADOW BANDS

AT the time of the eclipse on January 24 the writer attempted to photograph the shadow bands by means of a motion picture camera. A ground glass screen 60 x 80 inches was mounted between the camera and the sun, about 14 feet from the camera, and the camera was focused on the screen. Credit is due to Dr. J. A. Anderson, of Mount Wilson Observatory, for suggesting this method, which, if the screen has the proper degree of scattering, affords a better illuminated field than can be otherwise obtained.

Unfortunately, the bands were very indistinct in Middletown. The ground, walls of buildings, etc., seen by the waning light of the sun, appeared as if viewed through a rising column of warm air. This appearance is clearly visible on the film. The exposure began two minutes before totality and was continued at intervals until totality commenced. When projected on a screen, the film reveals a fine-grained, quivering, mottled pattern of light and shade, becoming coarser and more ragged as totality approaches.

The writer, who was taking notes near the camera during the exposure, clearly perceived the flickering play of light and shade over his writing tablet, though he could not distinguish any particular direction of motion of the "bands." For a few seconds the tablet was clearly crossed by a series of faint parallel bands, estimated to be about three centimeters apart and a few millimeters wide.

No bands nor definite drift of the "shadows" can be detected with certainty on the film. Similar results were also obtained on the film after totality.

WALTER G. CADY

WESLEYAN UNIVERSITY
MIDDLETOWN, CONN.

SOME COLLOÏD PHENOMENA IN THE ROCKY MOUNTAINS

THE large amount of limestone in the Rocky Mountain region seems to be responsible for the peculiar bluish tone of color so often noted in glacial streams there; for the softness of this mineral is especially favorable to the formation of colloidal material as a result of glacial abrasion. The torrent which issues from the Victoria glacier towards Lake Louise in the Canadian Rockies has in its upper reaches a milky or brownish cast, the blue shade developing only after the relatively large particles have been deposited, mainly at a spit where the stream debouches into the lake. Some of the small side pools show the bluish cast. Dr. J. H. Mathews informs me that a chain of lakes fed from Arapohoe Glacier, Colorado, show similar progressive color change.

Another item of interest is found at Mammouth Hot Springs in Yellowstone Park. The travertine formation being laid down by the springs at present is amorphous or cryptocrystalline (Jupiter Terrace); while the upper formation, estimated to have been laid down between twenty and thirty thousand years ago, is distinctly crystalline and sparkling. Indeed in walking from the one up to the other, the progressive change can easily be noted, and the wavy formation seen in the new deposits still persists in the old, notwithstanding the crystallization. How often experimenters fail to obtain certain results because they do not wait long enough! But nature has endless time and patience.

JEROME ALEXANDER

NEW YORK, N. Y.

BUSINESS METHODS

I WENT into a large manufacturing establishment, where the latest and best machinery was employed. The manager took me over the place, and introduced me to the famous experts who were in charge of the various details of production. He showed me maps, on which were indicated the routes of his explorers, who went every year in search of raw materials. He took me into the store rooms, where these materials were accumulated in vast amounts. He explained, with much enthusiasm, how the world needed the products of his firm, and proved by excellent arguments that its very prosperity and progress depended upon the supply. He cited the best and most distinguished authorities in support of his opinions.

I could hardly express my wonder and admiration. I said, with emotion, "It is marvelous to think of all these useful products, about to be distributed to the entire world, and of all the good they will do." At this point the manager seemed to hesitate a little, and the smile faded from his face. "The fact is," he said, "we can not afford to market our goods, except to a quite limited extent. It is quite true that they would be of great value, could we get them to the people, but this year's appropriations for marketing were long ago exhausted, and next year's will be even less sufficient." I then said, "What do you propose to do?" He smiled apologetically and said, "Really, we can not do anything."

Where was this factory, and who was the manager? It was the United States Government or any large museum or university in the land! Here is some recent evidence:

"I have two important papers that probably will not see the light for a year or more. Sooner or later we will have to come to the rationing method and apportion to each department so many pages per year."—Letter from one of the most distinguished workers in a large museum, December, 1924.

The United States Printing Office can not or does not nearly meet the requirements of the U. S. National Museum. It is true that the actual printed output is large, but it is not nearly what it would be if all the work done, or capable of being done, were fully utilized.

The *Nautilus,* the American journal dealing with the Mollusca, reporting in the main work done by the National Museum, Philadelphia Academy, etc., has to be subsidized out of the pockets of the editors, and will have to suspend if the support given to it is not increased. (England supports two such journals.)

There is a much older and more famous American scientific journal which is heavily subsidized by the editor, but I am not at liberty to cite the name.

Entomological News, another leading scientific journal, is finding it impossible to continue on the present basis.

Writers of monographs have to split them up and publish the fragments, in order to get any publication at all.

Museums contain valuable materials which are not studied because the results could not be published.

All this is happening in the richest country in the world. Why? Because men of science do not see things in a large way, and do not stand together. Because many, who should be supporting science and education, are absorbed in the pursuit of wealth. Because the results of scientific work have not been presented in a sufficiently intelligible way, and this is partly due to the condensation necessary on account of the conditions described. Democracy can not succeed without publicity, and no one knows what might be done if men of science would unite in the effort to place their goods on the markets of the world. As it is, the hungry public, deprived of the bread of life, tries to find nourishment in cross-word puzzles.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

ATTENDANCE AT COUNCIL MEETINGS OF THE AMERICAN ASSOCIATION

FROM Professor Henry B. Ward has been received the following justly pointed note: "In the issue of SCIENCE for February 6 I find a list of the Association Council with a supposed record of attendance at the council meetings in Washington. I am reported as having been present at one meeting only, whereas I was present at all meetings and was late at one meeting only. I should not call attention to this matter and request the correction of the record if it were not that the comments in connection with the roll so directly criticize the absentees that I am unwilling to have the error in this case stand uncorrected."

It is unfortunate indeed that such an error as this should have occurred with reference to a council member whose record of attendance and active interest is so uniformly high as is that of Professor Ward. It is of course impossible to explain or excuse the falsification, which has, however, now been corrected in the official records of the permanent secretary's office. Experience demonstrates that the securing of an attendance record for the council meetings is, under the circumstances, not nearly so easy of accomplishment as might be supposed, and when errors do occur it is very fine indeed to have them promptly reported, as in the present instance. The method employed in securing these supposed records of attendance will be still further improved for future meetings and there is hope that errors therein may ultimately be wholly prevented. Errors should be reported to the secretary of the council.

Adverse criticism of absence from the council sessions (see pages 131 and 132 of SCIENCE for February 6) is generally just, and that there should be necessity for such criticism is naturally greatly regretted by the members of the association. The permanent secretary has been more than once instructed by the executive committee of the council to emphasize strongly the great desirability of full attendance at the council sessions. The affairs of the association are always greatly in need of the active interest of all council members.

We are very thankful to Professor Ward for his cooperation.

SAM F. TRELEASE,
Secretary of the Council
BURTON E. LIVINGSTON,
Permanent Secretary.

SCIENTIFIC BOOKS

Studies in Human Biology. BY RAYMOND PEARL. Baltimore, Md., Williams and Wilkins Co., 1924, 653 pp.

DR. PEARL'S volume, "Studies in Human Biology," consists of a collection of articles which are in most

cases reprinted, with only minor modifications or corrections, from the journals in which they originally appeared. The articles deal with a wide range of subject-matter, but in general they are concerned with problems of vital statistics which have been investigated by the mathematical methods of the biometrician. The first two contributions deal with the weight of the human brain and the relation between intelligence and head size, the author's results on the latter topic confirming the conclusions of Pearson that there is a slight but "no marked correlation between intelligence and the size of the head."

The next chapter on "Race crossing and the sex ratio" is based on data obtained from the city of Buenos Aires between 1896 and 1905. Comparing the sex ratios of offspring from pure and mixed matings, it was found that "the proportion of males to females is in every case greater when the parents are of different racial stock than when they are of the same." "This preponderance of males," it is stated, "appears not to be capable of explanation as the result of environmental or demographic influences," although Dr. Pearl does not consider his results as absolutely conclusive. It is not improbable, *a priori*, that the sex ratio in man is influenced by crossing. But it seems to us that Pearl's data, which have frequently been referred to in discussions of the subject, are quite inadequate to establish this fact. Reported sex ratios are liable to considerable fluctuation owing to peculiarities of social environment, as is illustrated in the next chapter on "The sex ratio among the Jews." After quoting some extraordinary sex ratios among the Jews of various countries—ratios such as 119.1, 129.5, 115.4, 133.1, 145.9 and even 177.4—and after comparing these with other and apparently more reliable data, Pearl has concluded, and we think rightly, that these high ratios are untrustworthy. In the light of these results, it might be thought that Pearl would have been led to regard with suspicion the result of his previous findings with data from Buenos Aires, but he has republished the original paper with little change. The sex ratios of the products of interracial crosses in Argentine are no higher than one might expect to find in any pure-bred stock. The difference in question is due to the fact that the sex ratios of the Argentine, 103.26 $\pm$ 0.69, and of the Italians, 100.77 $\pm$ 0.41, are unusually low. The Italian ratio, 100.77 $\pm$ 0.41, should inspire the student of vital statistics with extreme caution, especially since the sex ratio of Italians in Italy is essentially like that of most other peoples. In fact, as Gini has remarked, the sex ratio is one of the most constant characters of the human species. Nevertheless, we find that, for some reason, reported ratios are sometimes exceptionally high or low, but owing to the many circumstances that cause sex ratios, as reported, to vary, these records are for the most part unreliable.

Chapter five, on "Congenital malformations," represents the author's first paper on vital statistics. The mean age at death from congenital malformations was found to be about the same for men as for women, but "the variation in the age at death from such malformations, as measured by the standard deviation, is significantly greater in women than in men." Hence Pearl concludes that "in intensity or degree of the malformations woman is more variable than man." The character chosen as a measure of the degree of the malformation is duration of life, which is the only measure the statistics afford. But is it legitimate to argue that because women show a greater standard deviation than men as regards the *time* at which they die, the degree of malformation is more variable in the female sex? Men die much more frequently from malformations than women. This may be due in part to their greater weakness in their first years of life, when most of such deaths occur, although it might reasonably be held to indicate a greater extent of malformation in the male sex since the wider departures from the normal are naturally more apt to prove fatal. It is, we think, quite futile to attempt to gage the degree of malformation in the two sexes by the standard deviation in the ages of the two sexes at death. Pearl has shown in the next chapter on "Centering infant mortality" that the standard deviation in the age at death of infants dying in the first year is much greater for legitimate infants than for those which are illegitimate. As the latter, like the male sex, have a higher death-rate, this fact has, we think, an important bearing on the interpretation of the peculiar sex ratio of deaths from malformations.

Chapter seven, on "Mortality and evolution," begins with a criticism of the international classification of the causes of death, the author developing for the purpose in hand "an entirely different general classification of the causes of death on a reasonably consistent biological basis." This consists essentially in grouping causes of death under the organ systems whose breakdown leads to fatal results. A good deal of space is devoted to discussing the relation of the various categories of the international classification to the organological groupings, but this is preliminary to obtaining a numerical tabulation of the mortality rates due to diseases attacking the various organ systems. Having arranged the causes of death according to systems of organs, Pearl goes on to group dis-

eases on the basis of the germ layers from which the organ systems are derived. The chief offender among the germ layers is the entoderm; the mesoderm is next in order, and the ectoderm is the least liable to disease of all. The reader who may have been wondering what all these facts have to do with evolution is now given the evolutionary interpretation. "The ectoderm has changed most in the course of evolution, having differentiated an elaborate nervous system and sense organs as well as a specialized, adaptive outer covering." Hence the ectodermic organs "break down and lead to death less frequently than any others." The entoderm, on the other hand, is "a very old-fashioned and out-of-date ancestral relic," relatively little differentiated and hence a prey to frequent infirmities. The mesoderm with more differentiation meets with somewhat less frequent misfortunes. I can not but think that Pearl's evolutionary interpretations are somewhat forced. It seems more reasonable to interpret the results simply in terms of physiology. The entoderm with its moist surface exposed to an abundance of bacterial and protozoal infections, to say nothing of the attacks of other parasites, and subjected to the irritations due to dietary indiscretions and bibulous habits, offers a natural point of attack, and it is not surprising that it is afflicted by frequent ailments. Our poor entoderm may be old-fashioned and relatively undifferentiated, but there are more obvious explanations for its often infirmities.

The two following chapters on "The vitality of the peoples of America" and "Trends of vital indices" represent more important contributions. Both are based on compilations of recent statistics on births, marriages and deaths, and they endeavor to set forth the recent trend of vitality in the American people. Several important conclusions are drawn, many interesting questions are raised and, perhaps most valuable of all, attention is called to the shortcomings in our data needed for the final solution of many problems.

In the chapter on "The influence of physical activity upon mortality" Dr. Pearl presents evidence that high mortality after age 40 to 45 tends to be increased by hard physical labor. This is an important conclusion if it can be definitely established and evidence is cited to prove that the association between hard labor and high mortality, which Pearl finds to occur only *after* age 40 to 45, is not a secondary one, but due to the fact that hard labor is a frequent cause of physical breakdown.

Perhaps the topic of most general interest in Pearl's volume is his forecast of the future growth of populations. He has fitted the facts of population growth in several countries to curves expressed in a generalized equation and then made estimates of future population growth from the course of the curves. These curves, which are sigmoid in form, approach an upper horizontal line representing the theoretical upper limit of population growth. Some such curve, of course, had to be selected if predictions based on extrapolation do not lead to absurd conclusions. The date at which populations approach uncomfortably near the upper limit is for most countries not more than two or three generations in the future. The estimates would have been modified somewhat had Pearl considered various changes in boundaries which have occurred in several countries during the periods covered by the data. The United States in the period under consideration has really been a succession of countries, having added, through the Louisiana Purchase, the accession of Oregon and Washington, and the territories acquired after the Mexican war, a vast area, and several hundred thousand inhabitants. A curve of population growth under these conditions obviously differs considerably from what it would have been had the United States been confined to its original limits. The causes determining the rate of population growth are as yet very imperfectly understood, and the significance of the fact that such growth may be fitted to segments of curves is at present not apparent. We shall have to wait for some decades before we can safely formulate any general laws of population growth which have any biological significance. Pearl's curves have at least this much in their favor, that they represent population increase, after it has passed a certain point, as gradually approaching a fixed upper limit, and they harmonize fairly well with several predictions of population limits based on the probable capacity of the earth to supply food. All these predictions, as Pearl has pointed out, are made with the proviso that nothing unforeseen happens essentially different from the events which have influenced the history of population in this world up to date.

We can only mention various other contributions on other topics, such as the relation of heredity to tuberculosis; the biological factors in the epidemiology of influenza; biology and war; epidemic encephalitis; national food consumption and the interesting parallels between the mortality curves of Drosophila, Proales and man. Dr. Pearl's critical knowledge of biometric methods and his appreciation of the broader biological bearing of the problems he attacks give his contributions on these topics a unique value. Dr. Pearl is, as it were, breaking ground in the use of exact methods in fields to which their application is relatively new. They are fields in which there are many pitfalls, and if Dr. Pearl has not always succeeded in avoiding them he is much more wary than most of those who have ventured to draw many deductions from vital statistics. One discerns the in-

fluence of Professor Karl Pearson both in the matter and the manner of Dr. Pearl's productions. Although several of the articles are severely technical, they are written in an attractive style and the general reader who is interested in his own species, but who knows nothing of mathematics and little of biology will find in them material of interest. The serious student of human biology can not afford to neglect this volume.

S. J. Holmes

University of California

SPECIAL ARTICLES

UNICRYSTALLINE PALLADIUM WIRES

Various metals have within recent years been obtained in the form of "single crystal" wires, or wires in which the entire cross-section, save at exceptional points, is occupied by one crystal. The first metal to be so obtained appears to have been tungsten, and most of the subsequent studies of unicrystalline material have related to this metal. Other metals which have been prepared in unicrystalline form include molybdenum, aluminium, bismuth, lead, tin, zinc and cadmium, the work of Czochralski, of Polanyi and of Carpenter being particularly noteworthy in this connection.

Since the unicrystalline condition is the one in which a metal best lends itself to the investigation of many of its properties, experiments have been made by the writers with the purpose of producing unicrystalline wires of palladium. The palladium employed was a metal of exceptional purity, secured from the Bureau of Standards.[1] The treatment to which it was subjected consisted in causing the wire, after it had been drawn down to a diameter of approximately 0.05 mm (2 mils) and slightly annealed, to pass at a rate of 9.4 mm per hour past two mercury contacts, 25 mm distant from each other, while a current of from 550 to 600 milliamperes entered the wire through the lower, water-cooled contact, and left through the upper contact, which was not thus cooled. A considerable temperature gradient was in this way maintained in the portion of the wire included between the contacts, of which the hottest part was at a "yellow red." An asbestos enclosure served to protect the heated wire from draughts of air, in order that the variations of temperature might be as small as possible.

Short pieces of the wires which had been thus treated were embedded in blocks of a 50 per cent. lead-tin alloy, which proved to have a convenient degree of hardness, and were then polished and simultaneously ground flat, with the finest grade of French emery paper. These specimens were etched by a three-minute immersion in a 1-normal solution of potassium bromide, saturated with bromine, or by a thirty-second treatment with aqua regia ($3\ HCl:1\ HNO_3$). Upon microscopic examination with vertical illumination, at a magnification of 200 diameters, they displayed clearly the appearances which Mark, Polanyi and Schmid[2] have described as characteristic of unicrystalline wires. Grain boundaries, while still to be found, occurred only at infrequent intervals; parallel etching lines marked the surface of the wire, and were unaltered in position by repeated etchings; and a system of ellipses, in planes which were parallel to each other but not to that of the etching lines, indicated points of incipient slip. In regions where the wire had been subjected to more than the average longitudinal stress it was seen to be constricted in one axial plane, but not in the plane normal to this, so that a ribbon had resulted. The fractured ends of treated wires which had been loaded to the breaking point exhibited a smooth plane of fracture, which formed an acute angle with the axis of the wire, instead of showing the irregular or cupped fracture of microcrystalline or untreated wire.

Rough measurements of the ductility of the wires, made by gradually increasing the tension upon lengths of from 80 to 159 mm, until rupture occurred, gave elongations which ranged from 0.7 to nearly 4.0 per cent. for three treated wires, while for two pieces of the untreated wire the elongations were too small to be measured by the method employed, being less than 0.2 per cent.

While no Roentgenographic examination has been made, it is therefore evident that palladium wires treated in the manner indicated are unicrystalline, and it is intended to study them further in respect to their occlusion of hydrogen, and to certain of their electrical and magnetic properties.

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GEOLOGICAL OBSERVATIONS ON THE ISLAND OF MAUI, HAWAII

The island of Maui, the second largest of the Hawaiian group, is the principal section of a great vol-

[1] The palladium was from that prepared in the recent investigations of the Bureau of Standards upon the platinum metals and came from a particular lot reported by the bureau in April, 1924, to be "nearly spectroscopically pure, containing a trace of calcium, but purer than any other palladium made or procured by the bureau."

[2] Mark, Polanyi and Schmid, *Zeit. Physik.*, 12 (1923), 58–72; 78–110; 111–116.

canic structure which includes in addition the islands of Molokai (with the submerged Penguin Bank extending westward from west Molokai toward Oahu), Lanai and Kahoolawe. The Maui group, a term suggested for this structure as a whole, comprises at least six principal eruptive centers, two each on Maui and Molokai, and one on Lanai and on Kahoolawe. The significance of the Penguin Bank is unknown. It may be the summit of a volcanic mountain which was not built above the level of the ocean, but more probably it represents a formerly emergent island which has been completely eroded or has subsided below sea level. The depths over most of the Penguin Bank are from 20 to 40 fathoms. If the bank be an eroded island, the outer margins doubtless consist of detritus derived from the former land mass by streams or by wave-attack along the shores together with a certain amount of organic débris. The inner portion is a wave-cut basaltic platform on which is a relatively thin veneer of sediment and reef limestone; the hydrographic charts note the widespread distribution of sand, coral and shells over the bank.

Whether the members of the Maui group were ever connected above sea level is uncertain, but their close submarine relations are clearly shown on the hydrographic charts of the islands. Submergences of greater magnitude than the depths of water in any of the channels between the islands of the Maui group apparently have taken place in Hawaii; hence exposed connections may have formerly existed. For example, large sections of the islands of Molokai and Niihau have been down-faulted below sea level; the depths of water within four miles of the faulted coasts are from 328 to 466 fathoms in the case of Molokai and from 240 to 319 fathoms in the case of Niihau. The Maui group is separated from Hawaii by a channel 30 miles wide and from 1,000 to 1,800 fathoms deep; the channel between the Penguin Bank and Oahu is about 12 miles wide and from 300 to 375 fathoms deep. The submarine connection between the Maui group and Oahu, therefore, is much closer than with Hawaii. It is not improbable that Oahu and the Maui group form a huge, complex lava dome; Hawaii, with its five major eruptive centers, is a separate volcanic unit.

The island of Maui is composed of two domes, connected by a low saddle, not more than 250 feet in elevation above sea level. Haleakala, east Maui (elevation, 10,032 feet) is a young dome with its constructional surface and its many parasitic cinder cones for the most part well preserved. On the northern, northeastern and southeastern slopes, the heavy trade wind rainfall has given rise to numerous streams which have cut deep, young canyons into the flanks of the dome, thereby exposing limited sections of the underground structure. Broad, practically undissected, tabular interfluves separate the valleys. The rainfall over the southeastern slope is lighter than over the northern section; hence the gorges are less numerous and not so deep. The heads of the valleys are a considerable distance below the summit of Haleakala, which projects well above the zone of maximum rainfall. The upper portion of the windward slopes and practically all the leeward slopes are virtually untouched by erosion. In the rainy section, deep weathering of the surface lavas has produced a thick soil cover, which supports a dense growth of vegetation. On the drier slopes, the decomposition of the lavas has been relatively slight, and the covering of natural vegetation is sparse. The cinder cones vary in age, and consequently in their stage of dissection. The oldest cones on the windward (northern and northeastern) slopes have been most deeply eroded. The windward coast of Haleakala has been wave-cliffed to some extent; the leeward coast shows little cliffing.

At the summit of Haleakala is the great faulted depression for which the island of Maui is so justly famous. The structure is 7.8 miles in length and 2.3 miles in width; the walls are steeply sloping scarps 2,000 to 2,500 feet in height. Two fault-gaps, one on the northern and one on the eastern side, break the continuity of the walls. On the relatively flat floor of the depression are a number of very recent cinder cones and lava flows; some of the latter have cascaded down the slopes of the mountain through the discharge-ways provided by the two fault-gaps. The scarps have suffered more or less dissection especially on the eastern side where the rainfall is heaviest. The original form of the cinder cones is almost perfectly preserved, and the ejectamenta composing them have been lateritized only to a very slight degree. The depression has been explained both as a volcanic rent and as a volcanic sink; insufficient field work has been done to determine the exact nature of the dislocation. If the structure be a rent, it is the sole example of its kind described in the world; if a sink, it represents a form transitional between the small sinks, such as are present at the summits of Kilauea and Mauna Loa on Hawaii, and the great, amphitheater-like structures which have been formed by the down-faulting of major sections of Kauai and of east and west Oahu. The relation of the movements which produced the fault-gaps to the development of the main depression have not been ascertained.

From geomorphologic evidence, Haleakala appears to be slightly older than Mauna Kea, Hawaii, whose erosional features closely resemble those of the former dome. The fluviatile dissection of the windward

slopes of Mauna Kea is not so far advanced as on windward Haleakala, although the rainfall and consequently the rate of erosion over the two domes is about the same. The principal volcanic center on Haleakala probably became extinct in the late Pleistocene, though the eruption of the cinder cones and lava flows in the summit depression evidently took place much later, since they are definitely younger than the lavas of the surrounding scarps. Subsidiary activity continued as late as 1750, when small flows from fissures not far from sea level on the southwestern side buried part of a Hawaiian village.

Whether all activity has ceased or whether further eruptions from lateral fissures or vents may yet take place is, of course, uncertain; the principal vent, however, appears to have been finally sealed. Subsidiary activity on Mauna Kea apparently ceased earlier than on Haleakala. Only two of the principal Hawaiian vents, Mauna Kea and Hualalai on the island of Hawaii, have become extinct since the cessation of the major eruptivity of Haleakala.

No evidences of glaciation have been found on Haleakala, while small moraines have been discovered at the summit of Mauna Kea (elevation 13,825 feet). The considerably lower elevation of the summit of the Maui dome (10,032 feet) probably accounts for this.

West Maui (elevation 5,788 feet) is a much smaller and older dome which has been greatly dissected by streams radiating from a small summit plateau, the center of the heaviest rainfall and the principal watershed. The fluviatile topography of the dome is submature, but the heavier rainfall over the windward slopes has caused more rapid erosion and consequently a somewhat more advanced topographic development of that section of the dome. The streams have cut very deep, narrow canyons, having huge, amphitheater-like heads and long extents of cliffed walls throughout their courses. The interfluves are fairly broad near the shore; inland, where the multiplication of tributaries has resulted in more extensive erosion of the dome, the divides are narrow, serrate ridges. The headward growth of the canyons has not yet reached its ultimate goal, hence the slightly dissected summit plateau, a remnant of the original constructional surface, has been preserved. Stupendous sea-cliffs have been cut into the northern and northeastern coasts; low cliffs are present locally along the leeward shores. Judging from the extent of fluviatile and marine erosion, the principal eruptive center on west Maui became extinct late in the Tertiary. As on all the extinct domes in Hawaii, activity continued intermittently from subordinate centers after the sealing of the main vent. The completion of the west Maui and the Kauai domes probably took place at approximately the same time. Kauai has been more deeply eroded, but this appears to be due to the heavier rainfall over its windward slopes and summit plateau, the larger area of its watersheds, the greater volume of its streams, and the consequently more rapid rate of erosion over most of its surface.

Splendid sections of the underground structure of the west Maui dome are exposed in the great canyons and in the sea-cliffs. Maui thus is an especially attractive field for the geologist, since side by side are two lava domes, one possessing, with only slight erosional modifications, the original constructional outlines, and the other exhibiting sub-surface relations as the result of the long erosion to which it has been subjected.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMEMT OF SCIENCE

MEDICAL SCIENCES AT THE WASHINGTON MEETING

(*Reports for Section N and the Federation of American Societies for Experimental Biology appeared in Science for February 6.*)

The American Physiological Society

President, A. J. Carlson.

Secretary, Walter J. Meek, University of Missouri, Columbia, Mo.

(*Report by Walter J. Meek*)

THE thirty-seventh annual meeting of the American Physiological Society was held December 29, 30, 31, with members present from all parts of the United States. Among the items attended to at the business meeting are the following: Announcement was made of the continuation of the Wm. T. Porter Fellowship for Physiological Research, administration of which has been entrusted to the Physiological Society. Dr. A. J. Carlson was reappointed as representative of the society to the National Research Council. As representatives to the Union of American Biological Societies, the Physiological Society reelected C. W. Greene and A. J. Carlson. Dr. Greene's report that plans for *Biological Abstracts* were well under way was heard with approval. The annual editorial and financial reports of the *American Journal of Physiology* and of *Physiological Reviews* showed a profitable year and a slight increase in the credit balance of these publications. Dr. D. R. Hooker was elected managing editor of the *American Journal of Physiology* for 1925. The council named

as the editorial board of *Physiological Reviews* for 1925 the following: William H. Howell, *chairman,* J. J. R. Macleod, H. Gideon Wells, W. J. Meek, C. W. Edmunds, Laurence J. Henderson and D. R. Hooker. The officers elected for the year 1925 are as follows: A. J. Carlson, University of Chicago, *president;* Walter J. Meek, University of Wisconsin, *secretary;* C. K. Drinker, Harvard Medical School, *treasurer;* Joseph Erlanger, Washington University Medical School, *councilor* for 1925–28. Twenty-two members were admitted to the society. It was decided that the annual meeting for 1925 should be held at the School of Medicine, Western Reserve University, Cleveland, Ohio.

The program throughout was of great scientific interest. Individual papers were well prepared and excellently presented. The range of subjects was wide, the majority falling however under the titles of "Internal secretions," "Circulation," "The nervous system" and "The effects of light." A total of 116 titles were presented to the Physiological Society. As a result of this large number many had to be placed on the title list. In the future, if necessary, the secretary was authorized to schedule simultaneous sections on special topics. Three joint sessions were held; the first with Section N and the Federation of Experimental Biology and Medicine, the second with the federation alone, and the third with the botanists and plant physiologists.

The last-mentioned program deserves a word of special comment. It was the first attempt to bring animal and plant physiologists together. The papers had to do with the biological effects of light. A very large audience attended the excellent presentations made by Drs. Popp, Arthur, Hinrichs, Hess, Clark, Steenbock and Moore. The feeling was general that such joint sessions on common fields of science are exceedingly stimulating and should be encouraged. Preceding adjournment the American Physiological Society passed a resolution thanking the executive secretary, Dr. E. B. Krumbhaar, and the local committee for their many courtesies.

The American Society for Pharmacology and Experimental Therapeutics

President, John Auer.

Secretary, E. D. Brown, University of Minnesota, Minneapolis, Minnesota.

(*Report by E. D. Brown*)

The sixteenth annual meeting of the society, held at Washington, was not a record breaker in point of attendance, there being a noticeable absence of some of our prominent veteran members, but it was nevertheless a grand success from the standpoint of character and number of papers presented. Several papers dealt with toxicity and impurities present in alcohols and the various general anesthetics, which were very interesting. About the usual number of papers were also presented which added to our knowledge of the arsenical compounds. Dr. Louise Pearce, of the Rockefeller Institute for Medical Research, gave a talk on the "Results obtained with tryparsamide in African sleeping sickness as indicated by examination of patients two to three years after treatment." Those who have been following the work done by Dr. Pearce will be interested to learn that the results obtained have been very promising. A fairly large percentage of the treated patients who have been under observation during the last two or three years have shown no symptoms of recurrence of the disease and examination of the cerebrospinal fluid showed no evidence of the presence of trypanosomes. The other papers on the program dealt with various subjects pertaining to pharmacology and were both interesting and instructive. They brought forth considerable discussion.

The demonstrations were unusually large in number and very interesting, but unfortunately the space available was inadequate to handle the crowd and afford an opportunity for those primarily interested to see them all.

The American Society of Biological Chemists

President, Philip A. Shaffer.

Secretary, D. Wright Wilson, University of Pennsylvania, Philadelphia, Pa.

(*Report by D. Wright Wilson*)

The American Society of Biological Chemists met with the other societies of the Federation of American Societies for Experimental Biology in association with the American Association for Advancement of Science in Washington, December 29, 30 and 31. Nearly 100 members attended the meetings. Of the many subjects discussed in the 51 papers presented at the sessions of the society only those of most general interest can be mentioned here. Studies of oxidations and reductions in the organism were discussed. The physical chemistry of blood received attention in studies on the ion activities in plasma and corpuscles. New observations on the molecular weights of proteins were reported as well as other studies on the chemistry of proteins. Many phases of metabolism were discussed in detail. Studies of carbohydrate metabolism were reported by many investigators from the points of view of the utilization of sugars, the formation of lactic acid and ketogenesis. Several reports on the action of insulin in the organism led to the general conclusion that many mysteries still

remain to be solved in connection with this interesting extract. Fat metabolism was studied chiefly from the point of view of determining the types of fat and fatty acids formed in the organism and present in the blood and in the feces. Mineral metabolism was discussed in detail with the main interest centering around the metabolism of calcium.

Among the most interesting papers of the whole program were a series on vitamins. Steenbock (University of Wisconsin) and Hess (New York City) each reported experiments on the recent discovery that ultraviolet light can impart antirachitic properties to certain substances previously inactive in this respect. Cholesterol is the only highly purified substance which the investigators have activated. This observation opens up a new point of view concerning the function of cholesterol in the body. Further reports were made on the reproductive vitamin (X or E). The investigations on vitamin B were placed on a more quantitative basis.

The more chemical papers of the joint meetings of the federation may be mentioned. L. J. Henderson (Harvard University) presented an outline of a mathematical study of the enormously important function of the capillaries in taking care of the greatly variable needs of the tissues. By great variations in the size of the capillary bed, oxygen may be furnished in suitable quantities and CO_2 may be removed. J. B. Collip (University of Alberta) reported the discovery of an extract of the active principle of the parathyroid which is capable of curing parathyroid tetany in dogs and raising the calcium of the blood in normal and parathyroidectomized animals. A startling result of an overdose of the extract is the great loss of plasma from the circulating blood. Mansfield Clark and collaborators (Hygienic Laboratory, Washington, D. C.) presented a study of the biochemical reduction of methylene blue with explanations which may be applied to reductions in living tissues in general. Gesell and collaborators (University of Michigan) reported the further studies on the stimulation of the respiratory center. Data were presented to prove that the reaction of the circulating blood is not the factor controlling the stimulation of the respiratory center. These investigators believe that the condition within the center itself is of greater importance.

The American Society for Experimental Pathology

President, A. S. Warthin.

Secretary, E. B. Krumbhaar, Laboratories, Philadelphia General Hospital, Philadelphia, Pa.

(*Report by E. B. Krumbhaar*)

Below is given a cursory summary of some of the most striking features of the Washington meeting of the society. Peyton Rous, of the Rockefeller Institute, gave a very suggestive and interesting report on the reaction to indicators of living mammalian tissues. The whole animal having been colored with the dye by injection, his tissues were examined (partly dissected and spread out under oil) and the color of the indicator seen to change under various treatments, such as etherization and asphyxia. A. W. Rowe, of Boston University, offered practical improvements in Dreyer's standards for vital capacity. Montrose Burrows, who has done such important work on tissue cultures, described a method of identifying growth-promoting substances *in vivo* and applied it to a study of a so-called ovarian hormone. Two papers by T. G. Miller, of the University of Pennsylvania, and Hartmann, of the Ford Hospital, Detroit, on blood sugar studies, emphasized the need of most careful controls of all the possible variables in increasing the value of the test and of the deductions that might be made. Thyroidectomy and thyroid feeding were found to have no effect on menstruation in the white rat (M. O. Lee), whereas Seecof found definite mitochondrial changes in the thyroid running parallel with experimental hyperplasia and hypoplasia. An interesting study by Weller, of Ann Arbor, of experimental meningo-encephalitis, produced by feeding lead to rabbits, showed the histopathology of this condition and demonstrated that extremely minute amounts of lead can now be detected in the tissues with the perfected Fairhall method.

A group of papers on hemolysis and allied topics was opened by two excellent presentations by McMaster and Elman, of the Rockefeller Institute, on the subect of urobilin. Whereas it has long been doubtful where urobilin is produced, the use of Rous and McMaster's bag for the collection of uncontaminated bile over long periods conclusively proved that urobilin is not formed in the liver and therefore must be formed in the intestine or in other places if bacteria have access. Its increase in hemolytic conditions shows its relation to hemoglobin and confirms the value of urobilin tests as indicators of the amount of blood destruction. Bodansky, studying the distribution between the blood plasma and corpuscles of unsaturated fatty acids, cholesterol and its esters in experimental anemia, claimed that they were kept not only within physiological, but within very close numerical limits. Whenever the size of the corpuscles was increased without any hemoglobin increase, there was an increase in the unsaturated fatty acids—an interesting sidelight on Bloor's hypothesis that red cells take up fatty acids to join with lecithin and other lipoids. The effect of cations on the sus-

ceptibility of erythrocytes to hypotonic hemolysis was found by S. C. Brooks, of the Hygienic Laboratory, as by previous observers, to be very different in different species. Cattle, for instance, unlike man, pigs and rats, have no potassium in their red cells. He also discussed Ashley's proposition that potassium chloride made cells rich in potassium more fragile, whereas sodium chloride made cells poor in potassium less fragile and vice versa. Mann, of the Mayo Clinic, divided the problem of experimental peptic ulcer into three chapters: (1) Formation; (2) healing; (3) chronicity. A method of forming ulcers had been devised whereby the current in the gut was so diverted that the alkaline secretion enters far from the acid. This almost always produced a chronic ulcer, which if untreated went on to perforation. Healing could be obtained in two ways; either by draining the stomach elsewhere (which, however, invariably produced a fatal ulcer in the new site) or by so anastomosing sections of the gut that the alkaline duodenal juice flowed over the ulcer. In two studies of renal function, F. M. Allen showed that the blood volume was increased in various experimental and clinical renal lesions, especially if water or salt solution was injected; and Isaac Starr, Jr., of Philadelphia, found that in unanesthetized rabbits prolonged injection of adrenalin produced albuminuria. In eviscerated, luminal dogs, temporary renal vaso-constriction, caused by asphyxia, carbon dioxide inhalation, or bleeding also caused albuminuria. This confirms Rich's prediction in 1922 that albuminuria could be caused by vaso-constriction. Clinical and experimental papers by Rowntree and Keith showed that the new drug Novasural had a marked diuretic effect on cases of cirrhosis and Banti's disease, but its mechanism was not made apparent by their experiments. Several metabolic papers were presented. Contrary to what one might expect, Smith and Anderson, of Yale, found that rats stunted by insufficient nourishment learned the intricacies of a maze with a food prize at the end quicker than their luckier and portlier companions. Discussion brought out, however, that there was also a psychological problem involved: necessity is the mother of invention and the hungry rats were undoubtedly under greater stimulus. One is reminded of the old story (fiction, of course) of the Yale and Harvard rats caught in a bucket of cream. The Harvard rat, realizing the hopelessness of the situation, soon drowned, while the Yale rat swam so hard looking for a way out that he soon churned a cake of butter on which he sat till help came. Two studies of energy metabolism should also be mentioned: one from the Michael Reese Hospital by Wang and her associates on under-nourished children, and one by Elizabeth Marsh, of the University of Rochester, on the effect of food and crying on the metabolism of full-time and premature infants.

On Wednesday morning Van Allen, of the Rockefeller Institute, introduced a simple but much more accurate method of determining blood coagulation. Taking as end point the first appearance of fibrin crystals under the microscope, instead of the usual test of clot consistency, he found a constant period in normal rabbit's blood between 20 and 30 seconds, which, however, was increased several hundred per cent. in abnormal conditions. This test was applied to Brown and Pearce's tumor-bearing rabbits. Dr. A. S. Warthin, the president of the federation, gave a clear summary of his experimental studies of the changes produced by irradiation in the cells of lymphangiomatous nevi. Clumping of cells, endothelial shrinkage, hydropic degeneration of epithelium, fusion into syncitial masses and stroma changes can only be referred to here. Continued persistence of clumps of viable cells emphasized the clinical fact that it is extremely dangerous to tamper with pigmented moles by insufficient means. If removal is attempted, it should be done most thoroughly, to prevent the dissemination of melano-sarcoma, one of the most malignant tumors known. A further study of experimental spirocheta cuniculi lesions in rabbits by Ruth Wanstrom, of Ann Arbor, confirms the conviction that the rabbit should be condemned as a laboratory animal on account of the frequency of spirochetal, bacterial and unknown spontaneous infections, which cloud the issue of experiments in such important diseases as syphilis, encephalitis and nephritis. The need for experimentalists to study the comparative pathology of this and other laboratory animals was also emphasized by this study. Fleisher, of St. Louis, found monilia in the feces, blood and skin scrapings of so many more cases of psoriasis than of normal individuals that he believes that a causal relationship exists. This view was strengthened by the clinical improvement that occurred after the use of vaccines prepared with these organisms. Nichols, the well-known syphilographer of the Army Medical School, from his studies on clinical yaws, in which he has found the gradual development of a positive Wassermann test, and of experimental yaws in the rabbit, believes that this condition is probably an unusual type of syphilis.

The Society of American Bacteriologists

President, A. Parker Hitchens.

Secretary, James M. Sherman, Cornell University, Ithaca, N. Y.

(*Report by James M. Sherman*)

The sessions of the Society of American Bacteriolo-

gists extended over three days, December 29 to 31, and included both morning and afternoon sessions, as well as two evening programs which were mainly social in nature. In all there were 104 scientific papers presented. Of these there were 36 papers dealing with general or pure bacteriology, 35 in the field of pathogenic bacteriology, pathology and immunology, 28 in the section on agricultural and industrial bacteriology, while a program of five selected papers was given at a joint meeting with Section N of the American Association for the Advancement of Science. The full proceedings of the meetings with abstracts of the papers will be published in an early number of the 1925 volume of *Abstracts of Bacteriology*. A number of important matters which affect the policies and activities of the society were dealt with in the business sessions, and among these the matter of the society's journals is one of the most important. The society voted to lend its support to and cooperate with the new *Biological Abstracts*, which is to begin publication under the auspices of the Union of American Biological Societies in January, 1926. The council of the society was authorized to negotiate with its publishers, with whom *Abstracts of Bacteriology* is jointly published, for the discontinuance of this journal at the end of 1925, so that the abstract work in the field of bacteriology may be consolidated with the new journal. This will allow the society to concentrate its efforts more on the publication of the *Journal of Bacteriology*, and the council was also authorized to negotiate for the publication of this journal as a monthly instead of bi-monthly, beginning January 1, 1926.

One of the most important transactions of the meetings had to do with the collection of type cultures which has been maintained by the Society of American Bacteriologists for the past few years. This collection was originally established at the American Museum of Natural History, by Dr. C.-E. A. Winslow, but was taken over a few years ago by the society, and has since been maintained by the society at the Army Medical Museum in Washington. The work of the past few years was made possible by a small grant from the society, together with the voluntary services of some of the bacteriologists located in Washington and the free housing facilities furnished by the Army Medical Museum. By means of a grant which has been secured by the National Research Council from the General Education Board, it has now become possible to make more adequate provision for the care and maintenance of this collection. Dr. Ludwig Hektoen, director of the McCormick Memorial Institute at Chicago, has offered the facilities of that institute for the housing of the collection, and arrangements have been made for its transfer to that institute in the near future. The general supervision of the collection will be vested in a committee representing the Society of American Bacteriologists, the Society of Pathologists and Bacteriologists, the American Phytopathological Society, the American Society of Zoologists and the McCormick Memorial Institute. The society also voted to continue the financial support which it has been giving the culture collection, in order to supplement the work which will be carried out under the enlarged program.

The officers elected for the year 1925 were: *President,* Normal MacL. Harris, Department of Health, Ottawa, Canada; *vice-president,* Hans Zinsser, Harvard University Medical School, Boston, Massachusetts; *secretary-treasurer,* James M. Sherman, Cornell University, Ithaca, N. Y.; *councilors,* C. C. Bass, E. B. Fred, I. C. Hall, K. F. Meyer. The 1925 meeting will be held at Madison, Wisconsin, December 29 to 31.

The Annual Conference of Biological Chemists

President, S. R. Benedict.

Secretary, Paul E. Howe, Washington, D. C.

(*Report by Paul E. Howe*)

The eighth annual conference of biological chemists was held in the Hotel Washington on December 29. The object of the conference is to promote biochemistry as a profession and as a unit of organization in the educational, research and industrial institutions of Canada and the United States.

This year Professor V. C. Myers, of Iowa State University, presented the report of a committee to propose "A model course of pathological chemistry for students of medicine." Subjects proposed for discussion next year were: "Could biological chemistry be made more useful to medical students, if, instead of a required course in physiological chemistry, or a unit of *formal* instruction, the special chemical phases of medicine were taught *informally* and whenever desirable, in a central laboratory, by a staff of teachers who would collaborate with officers in charge of major medical subjects or groups of subjects?" and "The teaching of quantitative biochemical methods in the medical curriculum." Discussion at the meeting this year indicated that there is considerable interest in both topics. It is not the intention of the organization to discuss solely biochemistry as related to medicine. The secretary will be glad to enter into correspondence looking toward the arrangement of meetings for the discussion of the problem of biochemistry as a profession or in other connections. The officers elected for next year are as follows: *President,* Professor W. R. Bloor; *vice-president,* Professor A. P. Mathews; *secretary-treasurer,* Professor Arthur Knudson (Albany Medical College, Albany, New York).